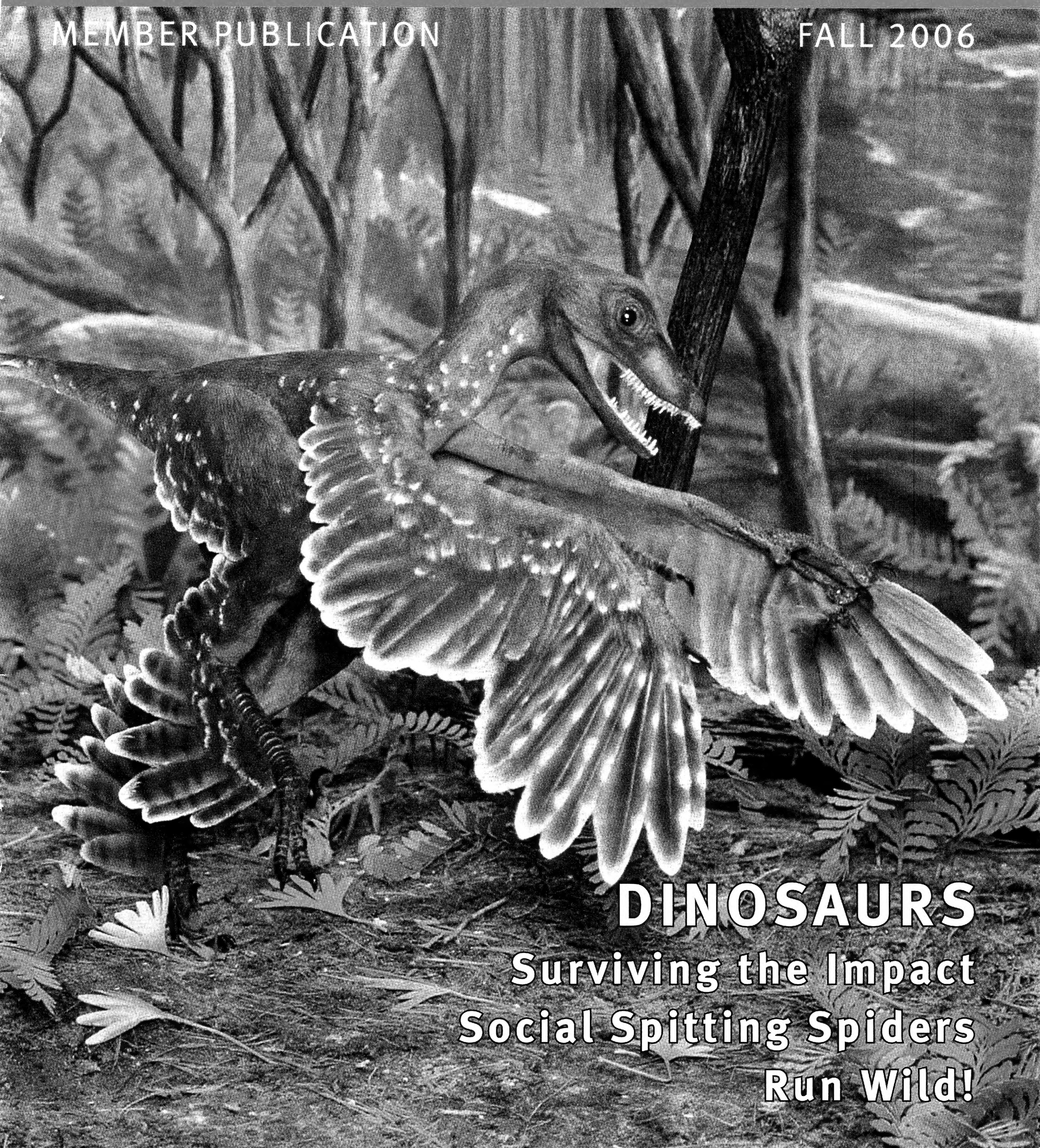
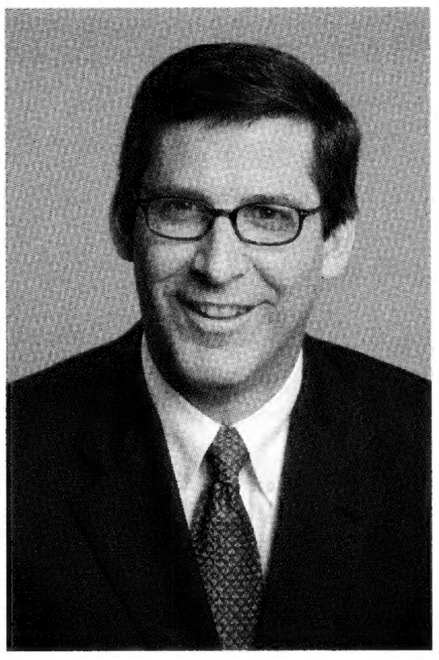
CALIFORNIA
# ACADEMY OF SCIENCES

MEMBER PUBLICATION

FALL 2006



## DINOSAURS
## Surviving the Impact
## Social Spitting Spiders
## Run Wild!



Every year, the Academy receives hundreds of inquiries from people of all ages and backgrounds who share one common passion: dinosaurs. They want to know if the Academy has any dinosaur fossils on display, or if we can help answer a question for them about the latest dino discoveries. As of September 16, the answer is a resounding yes. The Academy's newest exhibition, *DINOSAURS: Ancient Fossils, New Discoveries*, shatters many preconceived notions about these prehistoric beasts by presenting some of the most recent research in the fields of paleontology, biomechanical engineering, and paleobotany. Inside the exhibit, visitors can journey back 130 million years to walk amongst life-size models of dinosaurs and their contemporaries; watch a mechanical model of a *T. rex* skeleton walk in place; examine the evidence for feathered dinos; and explore interactive computer simulations and animations. Dedicated dinosaur fans will have five months to enjoy the exhibit, which will run through February 4, 2007.

Once the dinosaurs thunder out the doors, the main floor exhibit space they occupied will gradually be converted into supplementary space for Steinhart Aquarium. As Steinhart's biologists continue to acquire new animals for the future displays in Golden Gate Park, additional holding tanks will be added to accommodate the new arrivals. Expected additions include the sharks and rays that will swim in the new Philippine Coral Reef tank.

Other changes are also underway as we prepare for the opening of the new Academy. The late 2008 opening date that once seemed so remote is now just around the corner, and the time has come to start searching for a new Executive Director who will guide the Academy through the next chapter of its history. After nine years at the helm of the Academy, I am eager to return to my research and curatorial roles as the Hanna Chair of Diatom Studies. I will, however, continue to provide support to the Academy's senior leadership team throughout this extraordinary transformation, and I look forward to working closely with the new Executive Director once the position is filled.

Meanwhile, the new Academy building in Golden Gate Park continues to rise rapidly. The first pieces of curved roof steel have now been installed over Africa Hall, the largest aquarium tanks have all received their acrylic viewing panels, the new Morrison Planetarium dome is taking shape, and the rainforest ramp is beginning to spiral skyward. The new de Young Museum tower provides an excellent view of the Academy's building site—as well as the rest of San Francisco—so if you're in the neighborhood, it's well worth a visit. And, of course, you're always welcome to check out the new Academy model and future new Academy inhabitants here at Howard Street.

- Patrick Kociolek, Executive Director

MEMBER PUBLICATON

*Fall 2006, Issue No. 2*



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# DINOSAURS:

# Ancient Fossils, New Discoveries

*New exhibit roars into the Academy on September 16*

Northeast China, 130 million years ago. A vast lake stretches between towering stands of conifers and ginkgos. Sturgeons and turtles cruise the muddy waters, searching for food. Cicadas and dragonflies drone in the air. So far, a modern-day observer would find nothing astonishing or unfamiliar about this scene. But closer inspection reveals that this is, in fact, a very alien world. Not a single blade of grass exists. Something feathered glides through the trees, but it is not a bird. A slender tyrannosaur bends to drink from the edge of the lake. And a raptor dinosaur darts among the ferns, pursuing a pterosaur about to take off.

This ancient scene is depicted with breathtaking detail in the Liaoning diorama, one of many highlights in the new exhibit *DINOSAURS: Ancient Fossils, New Discoveries*. On display at the Academy from September 16, 2006 through February 4, 2007, *DINOSAURS* will bring visitors face-to-face—or face-to-knee, in some cases—with these popular behemoths of the Mesozoic Era. Besides the 700-square-foot Liaoning diorama, the exhibit features a 40-foot skeleton of *Tyrannosaurus rex*, posed dramatically in mid-stride and bearing down on visitors below; a 60-foot steel *Apatosaurus*, a model so large that visitors will have to walk under its arching tail and neck; a re-creation of the Davenport Ranch Trackway, which boasts a famous collection of dinosaur footprints that illustrates herding behavior; an entire wall of spiked, frilled, domed, and duck-billed skulls; and much more.

What makes the exhibit unique, however, is that it relates all of these elements to the current research and modern practice of paleontology. Gone are the days of dinosaurs portrayed as silent, inert skeletons hiding innumerable secrets. By combining forensic science, cutting-edge digital technology, and a multidisciplinary approach, today's paleontologists can rigorously examine fossil evidence and create a robust portrait of a living, breathing animal. In *DINOSAURS: Ancient Fossils, New Discoveries*, visitors will not only learn what each fossil reveals about a dinosaur's life history, physiology, ecology, and behavior, but also follow the reasoning and methods behind those interpretations.

For example, questions about how fast a *T. rex* could move are addressed using the field of biomechanics. Biomechanics employs physics and engineering to study animal motion, taking into account muscle mass, stresses on the bones and tendons, torque and friction, and energy requirements. Since all that remains of *T. rex* are the bones, paleontologists must rely on computer modeling and comparisons with living animals, such as ostriches, elephants, and cheetahs, to inform their hypotheses. They have determined that *T. rex* was

Photo by Craig Chesek, AMNH

*Beipiaosaurus, a beaked theropod covered with protofeathers, is featured in the exhibit.*

capable of moving only 7-10 miles per hour—a far cry from the thundering sprints depicted in *Jurassic Park*. This dignified gait is illustrated in the exhibit by a robotic *T. rex*, built at one-seventh scale.

Another question the exhibit poses is: What were the horns, frills, and domes found on many dinosaur skulls used for? Images of a strong-willed *Triceratops* may spring to mind, as it impales a charging *T. rex* with its horns in a titanic fight to the death. But by looking at modern horned animals—antelope, lizards, beetles—paleontologists suggest a more peaceful use for skull ornaments: species recognition and courtship. Visitors can survey an array of bizarrely adorned skulls and make up their own minds about the "fighting vs. flirting" debate.

especially in China's Liaoning Province, only strengthens this link. Liaoning serves as the inspiration for the exhibit's expansive diorama, and appropriately enough, many of its dinosaur models are depicted with feathers, like the thinly-coated *Dilong paradoxus*, the tree-gliding *Microraptor*, and the densely-plumed *Sinornithosaurus*.

The exhibit concludes with current extinction theories, ranging from a meteor impact to receding sea levels. The Academy has enhanced this portion of the exhibit with specimens from its invertebrate fossil collection, reminding visitors that dinosaurs were not the only

*The ongoing discovery of feathered dinosaurs, such as this Microraptor and the Sinornithosaurus (lower left), provides evidence for an evolutionary relationship with birds.*

Photo by: Craig Chesek, AMNH

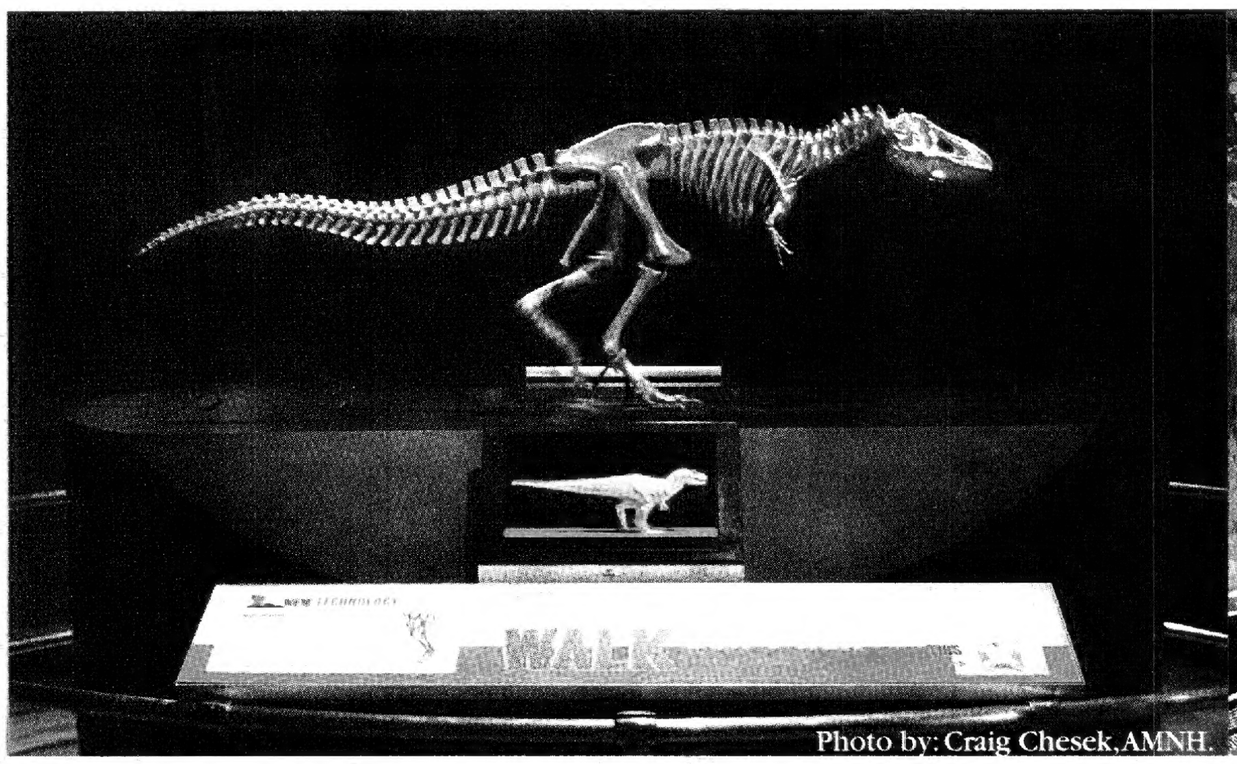


Photo by: Craig Chesek, AMNH.

*Paleontologists use the latest technology to bring dinosaurs to life. This six-foot-long mechanical skeleton demonstrates the typical speed and gait of T. rex.*

Photo by: Roderick Mickens, AMNH.

*The Liaoning diorama is the most detailed re-creation of a prehistoric environment ever constructed.*

Perhaps the most compelling revelation in the exhibit, however, is that dinosaurs still walk among us. Widely accepted by modern paleontologists, the idea that birds are the direct descendants of dinosaurs is supported by plentiful evidence, including X-rays, CAT-scans, footprints, and side-by-side fossil comparisons. The ongoing discovery of feathered dinosaur fossils,

casualties of the mass extinction 65 million years ago. In fact, 50% of all plant and animal species met their demise at the end of the Mesozoic Era.

"Ammonites, which are ancient relatives of the nautilus and squid, all went extinct, as did rudist clams, the major reef builders in the oceans," says Peter Roopnarine, associate curator of Invertebrate Zoology and Geology at the Academy. "We have one of the largest collections of Mesozoic ammonites in the world. Select specimens will be put on display to highlight the marine fauna that existed alongside the dinosaurs and died out with them."

By the time visitors reach the end of the exhibit, many of their long-held beliefs will also have gone extinct.

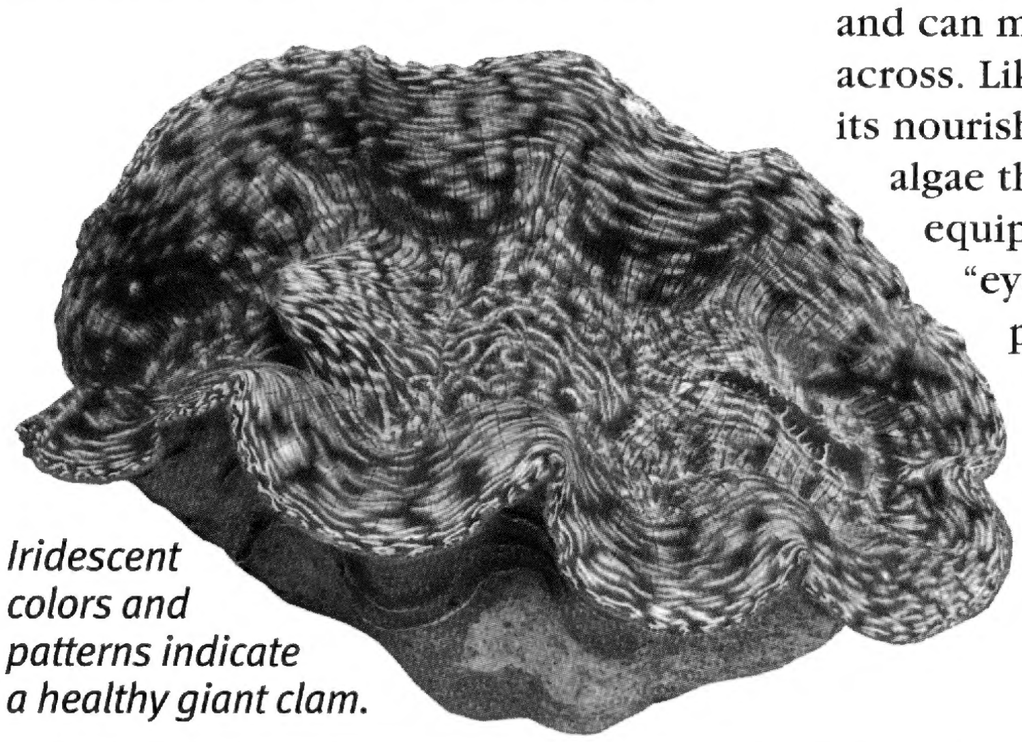
Although non-avian dinosaurs have been dead for 65 million years, *DINOSAURS: Ancient Fossils, New Discoveries* proves that the field of paleontology continues to evolve, and that the act of discovery is still very much alive.

Photo by: Craig Chesek, AMNH

**This exhibition is organized by the American Museum of Natural History, New York (www.amnh.org), in collaboration with the Houston Museum of Natural Science; California Academy of Sciences, San Francisco; The Field Museum, Chicago; and North Carolina Museum of Natural Sciences, Raleigh.**

# CLAMMING UP AT HOWARD STREET

Steinhart Aquarium biologists were as happy as clams when they received a recent donation—a new ten-pound, one-and-a-half-foot *Tridacna derasa*, or giant clam, which will eventually take up residence in the new Academy's Coral Reef display. *T. derasa* is native to Indo-Pacific reefs and can measure up to two feet across. Like corals, it obtains most of its nourishment from photosynthetic algae that live in its tissue. It is also equipped with hundreds of tiny "eyes" that detect shadows and prompt it to withdraw into its shell as a precaution against predators. The newly-arrived clam currently resides in the coral nursery on the second floor of the Academy.



*Iridescent colors and patterns indicate a healthy giant clam.*

Steinhart biologists are also rearing three other giant clam species for the new coral reef display: *Tridacna crocea, maxima,* and *gigas*. The latter, *T. gigas*, is the largest bivalve species in the world, growing to a maximum size of five feet and weighing up to 400 pounds. Though only a few inches long now, the *T. gigas* specimens will continue to grow for decades after the new Academy opens in 2008.

*The Academy would like to thank Richard Weeks of SEABay for the giant clam donation, and The Octopus's Garden in Berkeley for its recent donation of four reef fish.*

# IN SEARCH OF THE TAMBAQUI

Photo by: Dong Lin

When the new Academy opens in 2008, one of the highlights will be a four-story living rainforest, complete with a 100,000-gallon Flooded Forest display. Steinhart Aquarium biologists have been researching the Amazon Basin's flood plains for several years to determine which species of fish to include in the display. Recently, their research has led them to a quest for the elusive Tambaqui, or black pacu. Measuring up to 3.5 feet long and weighing up to 60 pounds, this species is the largest of the Amazonian seed-dispersing fish and plays an important role in the growth of rainforest trees. The fish, which move into the Amazon's flooded forests to reproduce, feed on fruits that drop from surrounding trees. The seeds pass unharmed through their digestive systems and take root when the floods subside.

Unfortunately, Tambaqui are becoming increasingly hard to find, due to deforestation, recognition of the fish's food value for a growing population, and improved fishing techniques. Steinhart biologists have ordered black pacu from wholesalers only to find red pacu masquerading as their relatives in the bag. Several aquaculturists have developed a promising new Tambaqui spawning technique using hormone injections. Unfortunately, Steinhart's biologists have yet to find an aquaculturist willing or able to ship 50-100 medium-sized live Tambaqui.

Although they are unlikely to provide large numbers of the fish, local aquarium hobbyists are a potential source of Tambaqui for the Academy. In the past, pet owners have purchased the fast-growing black bruisers thinking they were piranhas or other small Amazonian fish. Once the Tambaqui outgrew their home aquariums, the hobbyists were eager to find a place to deposit their fish. Additionally, recent reports of captive Tambaqui escaping into Florida's hurricane floodwaters have prompted Steinhart biologists to contact a colleague at the Florida Aquaculture Board. As a last ditch effort to acquire the rare fish, they have offered to help the state in its invasive species removal efforts by setting up large nets called seines to trap the Tambaqui.

Between hobbyist donations, the Florida aquaculture trade, staff seining operations, and assistance from research associates in Brazil, Steinhart's biologists expect visitors to be dazzled by schools of black Tambaqui in the coming months. The new acquisitions will be added to the "Amazon" and "Colossal Rivers" tanks at Howard Street as they arrive—look for them during your next visit.

*All programs are free with Academy admission unless otherwise noted.*

### Nature Nest: DINOSAURS!

***Every Day***

After checking out the *DINOSAURS* exhibit, be sure to come up to the second floor and visit the Nature Nest—a hands-on experience for children 5 and under. Dinosaur-themed puzzles, books, costumes, puppets and more await your child.

### Story Time

***Every Saturday; Every second & fourth Thursday* 10:30am**

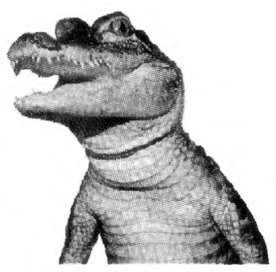
Children ages 3-5 are invited to join us for stories about the natural world.

### Raptor Dinosaurs

***Fridays, October 6, 27, November 3***
***Wednesday, November 22***
**11:30am & 12:30pm**

A lively presentation for all ages on *Velociraptor* and its close relatives. Academy "Dino Docent" Ralph Miller uses fossil casts and mechanical models to show you what these amazing Cretaceous killers were really like, inside and out.

### Halloween Herps



***Saturday, October 28***
**11:30am & 1:30pm**

Explore the mysterious world of reptiles and amphibians, and meet a frog, a boa constrictor and an American alligator.

### Snake Feeding

***Every Friday* 2:00pm**

Watch as an Academy biologist feeds the anaconda, python, vine snakes, and more, while answering all your SSssssnake-related questions.

### Penguin Feeding

***Every Day***
**11:00am & 3:30pm**

During daily penguin feeding shows, visitors may watch and ask questions as one of the Academy's aquatic biologists dons a wet suit and tosses vitamin-stuffed herring and capelin to the penguins. Each feeding takes 20 minutes.

### Coral Reef Caretaking

***Every Monday and Wednesday* 2:00pm**

Watch as an Academy biologist suits up in SCUBA gear and dives into the Academy's two-story Coral Reef tank to care for the reef's inhabitants. During this 20-minute dive, the biologist will clean the tank windows and feed the anemones and fish. A second biologist will be on hand to answer questions.

### 22nd BioForum Series for Science Educators

**Scientific Explorations in the Fungal World**
***Saturday, October 28, 2006* 8:30am–4pm**
***Oakland Museum of California, Oakland***

Fungi play a much larger role in our ecosystems than merely providing edible mushrooms. New discoveries are unfolding regarding the important symbiotic relationships between fungi and their host trees, the valuable ecological role that fungi play in forest communities, the fungal link to sudden oak death syndrome, and new potentials for mushroom medicinals and fungal ecorestoration. Scientists will share their recent findings on ecological relationships, environmental concerns and scientific breakthroughs in the fungal realm.

**Members $30; non-members $25; students $15. To pre-register call 415-321-8000.**

### *Take a Tour with* "GUIDE BY CELL"

Have you ever wished you could take an audio tour without the hassle or expense or renting equipment? The Academy is now testing an innovative new service that allows visitors to do just that. By dialing a special number on your cell phone during your next visit to the museum, you can listen to Academy scientists and Steinhart biologists talk about some of their favorite exhibit components, including the moon rock, the giant sea bass, the new coral rearing pods, and some of the historical artifacts in the Academy classroom. Information will also be available about the new Academy in Golden Gate Park. So dial in, and dive in to a whole new way to explore the natural world.

### Educator Resource Materials

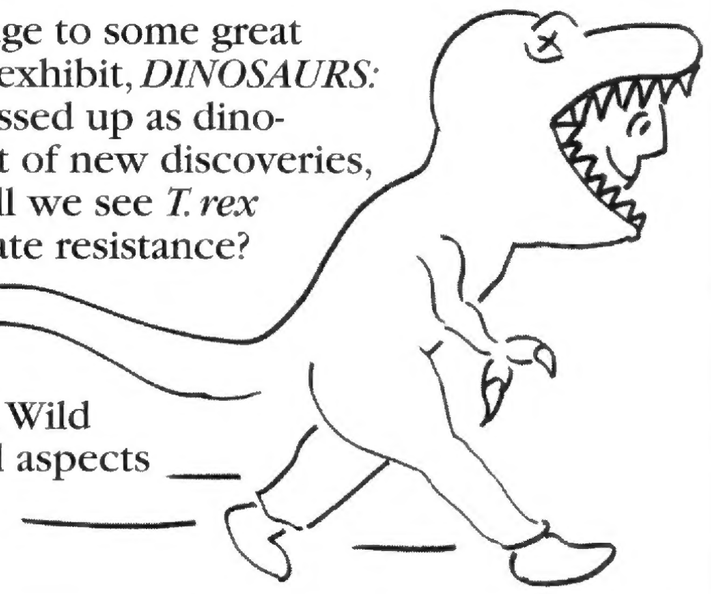
Does your child attend preschool or kindergarten? Are you a preschool or kindergarten teacher? The Academy has ERMs (Educator Resource Materials) available for use in a school setting. ERM Jr. kits are designed for children 4 to 6 years old. All kits feature animals and plants commonly found in the San Francisco Bay Area, with the exception of Dinosaur Days.

Themes include: Creepers & Crawlers, Busy Birds, Tide Pool Treasures, and Dinosaur Days. Each kit contains specimens, books, learning activities, and a detailed teacher guide. To find out more about reserving an ERM Jr. kit, call the Naturalist Center at (415) 321-8090.

## The 22nd Annual Academy Run Goes Wild in 2006

After 21 years of running to The Far Side®, the Academy is anointing its annual Thanksgiving Weekend race with a new name: Run Wild 5K/10K. Despite the name change, the run will continue to feature many of its most memorable traditions. It will still be held the Sunday after Thanksgiving, which falls on November 26 this year. Participants can mosey, waddle, walk, skip, or run their way to the finish line. Additionally, wild and crazy costumes are still encouraged in the 5K; the top ten costumes will be awarded cash and prizes. Finally, long-sleeve official t-shirts will be given to all registered runners/walkers, along with goodie bags and free refreshments.

The official logo this year will pay homage to some great prehistoric runners and the Academy's new exhibit, *DINOSAURS: Ancient Fossils, New Discoveries.* Those dressed up as dino-athletes are especially welcome. In the spirit of new discoveries, runners are encouraged to be innovative. Will we see *T. rex* tails suspended on a wheel or two to eliminate resistance?



Participants of all ages are invited to join in on the fun, from those just out of the egg to returning fossils. Pre-registration fee for members is $24. Run Wild is also looking for volunteers to help with all aspects of the race.

For more information or to receive an entry form, visit www.calacademy.org, call RhodyCo Productions at 415-759-2690, or email info@rhodyco.com.

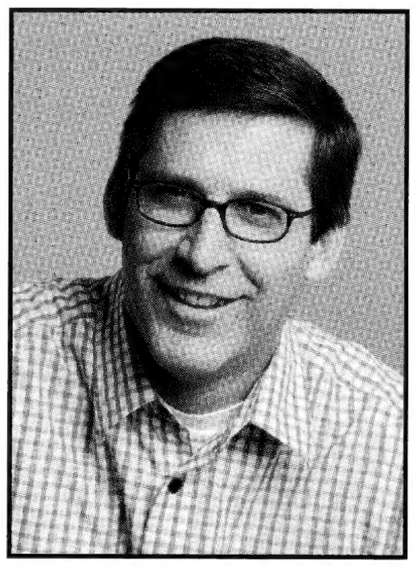
If you would like to volunteer, please call Cat Aboudara at 415-321-8122 or email caboudara@calacademy.org.

# ACADEMY LECTURES

Location: Sequoia Boardroom, California Academy of Sciences
Tickets: Free for Academy members, $8 non-members.
Tickets can be purchased by calling (415) 321-8000 or at the door, when available. *In lieu of a September Academy lecture, members will receive free admission to the September 28 lecture with Dave Quammen at the JCCSF.*

*SPECIAL FEATURE*

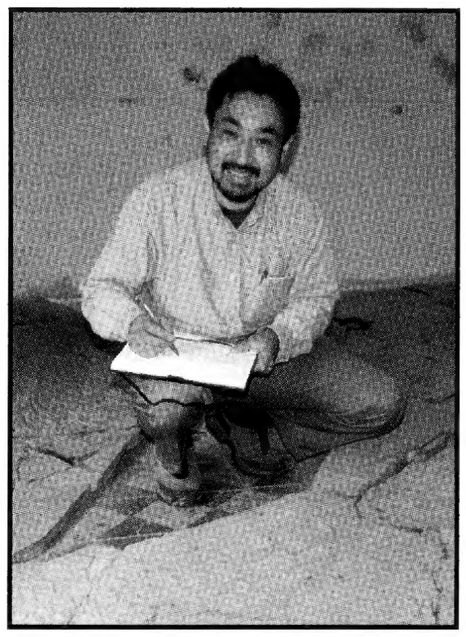
## Update: The New Academy!



**Patrick Kociolek, Ph.D.**
**Executive Director,**
**California Academy of Sciences**
**Tuesday, October 17, 2 pm & 7:30 pm**

As part of the Academy's effort to update its members on the progress of the new Academy building, Patrick Kociolek will take the opportunity to share both the grand vision of the new Academy and the details of this fantastic project. He will use up-to-date photographs of the construction site as well as three-dimensional models to illuminate the path of the Academy's imminent future.

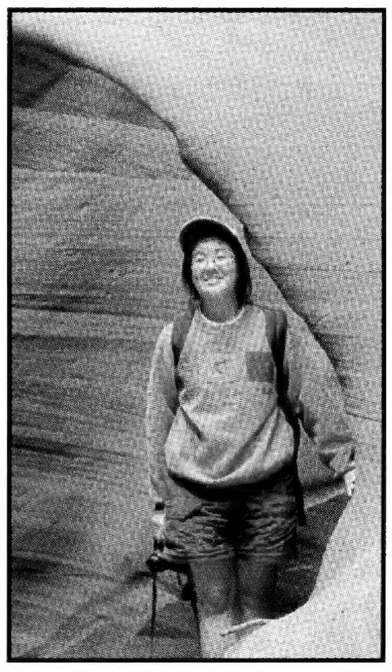
## The Rise and Demise of Sea Dragons: Ichthyosaurs



**Ryosuke Motani,**
**Associate Professor of Geology,**
**University of California, Davis**
**Tuesday November 7, 2 pm & 7:30 pm**

California hasn't always been known as the land of sunshine—it was actually underwater in the Age of Dinosaurs. From this time, there is a rich record of the "sea dragons" that prospered in the ocean, including the ichthyosaur *Californosaurus*. Ichthyosaurs invaded the seas in the wake of the worst mass extinction on this planet, and evolved from a lizard-shaped animal to fish-shaped forms. Join Motani, a world expert on the subject, as he explains some of their oddities, such as huge eyes that were 10 inches across or the presence of ten fingers in the hand-flipper.

## Jurassic Marine Park: Paleontology in the Western United States



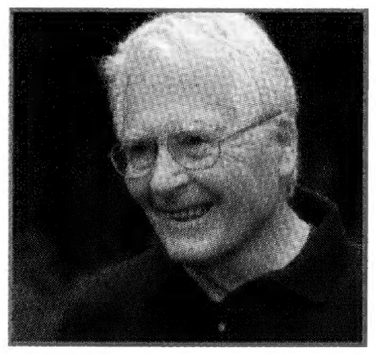
**Carol Tang, Ph.D.**
**Associate Director of Public Programs,**
**California Academy of Sciences**
**Tuesday, December 5, 2 pm & 7:30 pm**

While dinosaurs roamed the continents, the oceans covering the western United States teemed with marine life. The Jurassic was a time of great upheaval in the oceans with seaways opening and closing, unusual water chemistry, and unique sea floor sediments. For marine ecosystems, a "marine revolution" was brewing with a dramatic increase in species diversity, and organisms exploiting new habitats and new food sources. Join Tang for an exciting look at this prehistoric marine world.

# SPECIAL LECTURES

at the Jewish Community Center of San Francisco
Tickets: $8 members / $10 general admission / $6 students
Call: 415-321-8000

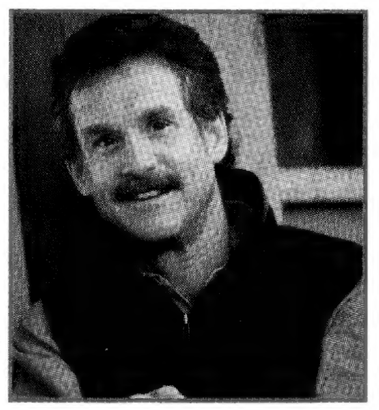
## A Conversation with James Lovelock



**Scientist, author, environmentalist**
**Wednesday, September 13, 8 pm**

Over twenty years after the development of his controversial Gaia theory, James Lovelock turns his formidable lens on our imminent global climate crisis. Lovelock's influential Gaia theory conceives of the Earth, including the atmosphere, oceans, biosphere and upper layers of rock, as a single living super-organism, regulating its internal environment much as an animal regulates its body temperature and chemical balance. But now, says Lovelock, that organism is sick. It is running a fever born of the combination of a sun whose intensity is slowly growing over millions of years, and an atmosphere whose greenhouse gases have recently spiked due to human activity. Lovelock explains the stress the planetary system is under, the ways humans are contributing to it, and what humanity must do to rescue itself.

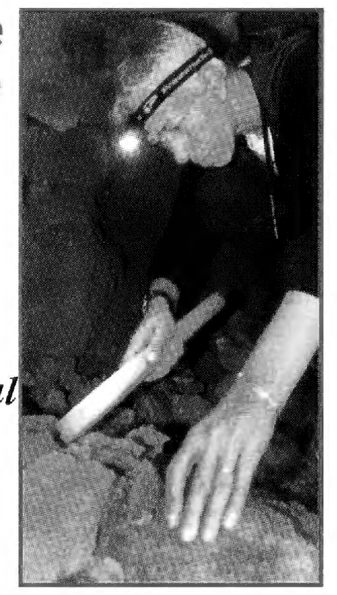
## The Reluctant Mr. Darwin



**David Quammen, Author,**
***Monster of God* & *The Song of the Dodo***
**Thursday, September 28, 8 pm**

Charles Darwin nursed his idea about the evolution of species via natural selection for years. It had both political and religious implications that he knew would trouble those around him, including his own wife. In his new book, *The Reluctant Mr. Darwin*, Quammen captures the private side of this famous scientist, the deeply conflicted man who would struggle for decades with the notion of publishing his thoughts. Quammen also traces the parallel career of another field naturalist, Alfred Wallace, whose famous letter to Darwin announcing his work prompted the older man to publication.
*Free for Academy members!*

## Human Skin: Past, Present, and Future



**Nina Jablonski, Ph.D., Professor & Head of the Department of Anthropology, Pennsylvania State University.**
*Co-sponsored by the Leakey Foundation*
**Thursday, October 5, 8 pm**

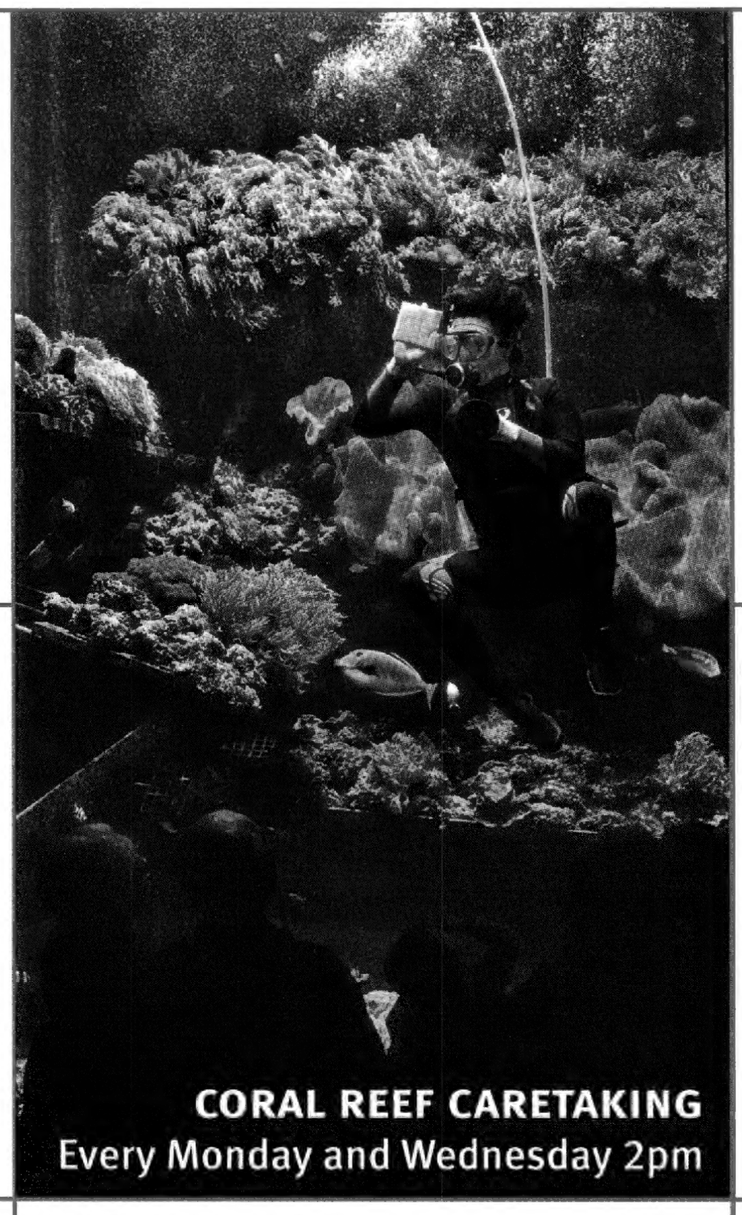
We expose it, cover it, paint it, tattoo it, scar it, and pierce it. In her new book, *Skin: A Natural History,* Jablonski places the rich cultural canvas of skin within its broader biological context for the first time, and the result is a tremendously engaging look at ourselves. She begins with a look at skin's structure and functions and then tours its three-hundred-million-year evolution, delving into such topics as the importance of touch and how the skin reflects and affects emotions. She examines the modern human obsession with age-related changes in skin, especially wrinkles. She then turns to skin as a canvas for self-expression, exploring our use of cosmetics, body paint, tattooing, and scarification.

# SEPTEMBER

*All programs are free with Academy admission unless otherwise noted.*
Please see Programs and Highlights on page 6 for a full description.
For more information, visit: *www.calacademy.org*.

***Dino-mite Deal:*** **Academy members will receive free admission to the *DINOSAURS* exhibit. Admission prices for non-members, however, will change during the reign of the dinosaurs. See page 17 for more details.**

| Sunday | Monday | Tuesday | Wedn |
|---|---|---|---|
| **3**<br>**Penguin Feeding** 11:00am<br>**Penguin Feeding** 3:30pm | | **5**<br>**Penguin Feeding** 11:00am<br>**Penguin Feeding** 3:30pm | **6**<br>**Penguin Feed**<br>**Coral Reef Ca**<br>**Penguin Feed** |
| **10**<br>**Penguin Feeding** 11:00am<br>**Penguin Feeding** 3:30pm | | **12**<br>**Penguin Feeding** 11:00am<br>**Penguin Feeding** 3:30pm | **13**<br>**Penguin Feed**<br>**Coral Reef Ca**<br>**Penguin Feed**<br>**Special Lectu** |
| **17**<br>**Penguin Feeding** 11:00am<br>**Penguin Feeding** 3:30pm | **18**<br>**Penguin Feeding** 11:00am<br>**Coral Reef Caretaking** 2:00pm<br>**Penguin Feeding** 3:30pm | **19**<br>**Penguin Feeding** 11:00am<br>**Penguin Feeding** 3:30pm | **20**<br>**Penguin Feed**<br>**Coral Reef Ca**<br>**Penguin Feed** |
| **PENGUIN FEEDING**<br>Every Day<br>11am & 3:30pm | **25**<br>**Penguin Feeding** 11:00am<br>**Coral Reef Caretaking** 2:00pm<br>**Penguin Feeding** 3:30pm | **26**<br>**Penguin Feeding** 11:00am<br>**Penguin Feeding** 3:30pm | **27**<br>**Penguin Feed**<br>**Coral Reef Ca**<br>**Penguin Feed** |



**CORAL REEF CARETAKING**
Every Monday and Wednesday 2pm

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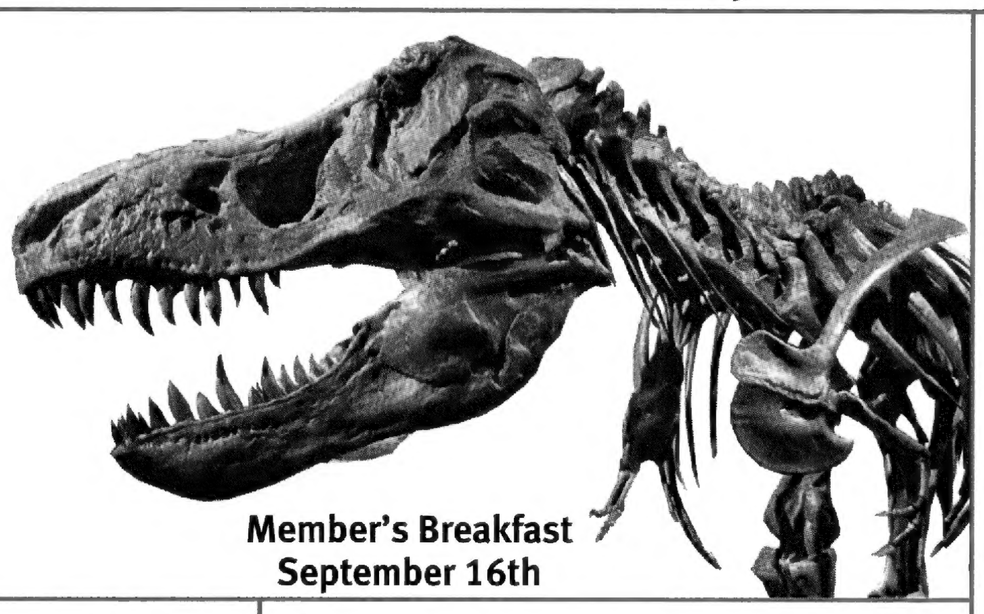
**SHOPPING ONL**
http://calacadem

**PENGUIN FEEDING**
Every Day
11am & 3:30pm

## esday | Thursday | Friday | Saturday



Member's Breakfast
September 16th

**SNAKE FEEDINGS**
Every Friday 2pm

**2**
- Story Time 10:30am
- Penguin Feeding 11:00am
- Penguin Feeding 3:30pm

**PENGUIN FEEDING**
Every Day 11am & 3:30pm

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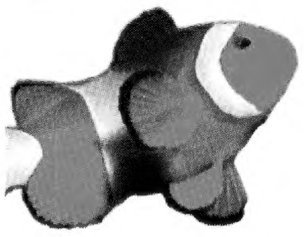

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**7**
- Penguin Feeding 11:00am
- Penguin Feeding 3:30pm

ng 11:00am
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e 8:00pm *JCC

**14**
- Story Time 10:30am
- Penguin Feeding 11:00am
- Penguin Feeding 3:30pm

**15**
- Penguin Feeding 11:00am
- Snake Feeding 2:00pm
- Penguin Feeding 3:30pm

**16**
- Member's Breakfast 8:00am *see pg 22
- *DINOSAURS* opens! 10:00am
- Story Time 10:30am
- Penguin Feeding 11:00am
- Penguin Feeding 3:30pm

ng 11:00am
etaking 2:00pm
ng 3:30pm

**21**
- Penguin Feeding 11:00am
- Penguin Feeding 3:30pm
- 3rd Thursday 5:00pm

3rd THURSDAYS
CLOWNFISH, CORALS & COCKTAILS CONVERGE

**22**
- Members Hours 9:30am
- Penguin Feeding 11:00am
- Snake Feeding 2:00pm
- Penguin Feeding 3:30pm

**23**
- Story Time 10:30am
- Penguin Feeding 11:00am
- Penguin Feeding 3:30pm

ng 11:00am
etaking 2:00pm
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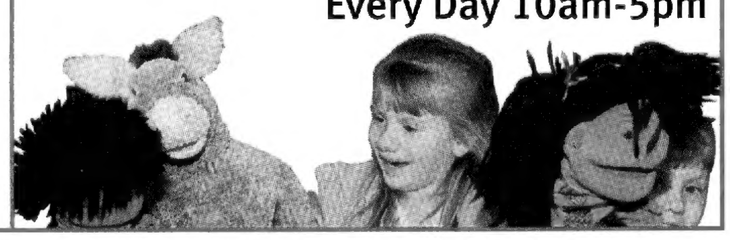
**28**
- Story Time 10:30am
- Penguin Feeding 11:00am
- Penguin Feeding 3:30pm
- Special Lecture 8:00pm *JCC

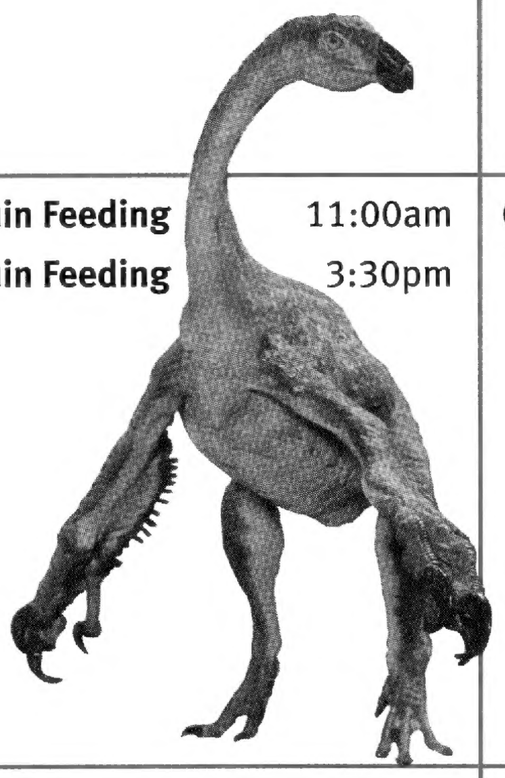
**29**
- Members Hours 9:30am
- Penguin Feeding 11:00am
- Snake Feeding 2:00pm
- Penguin Feeding 3:30pm

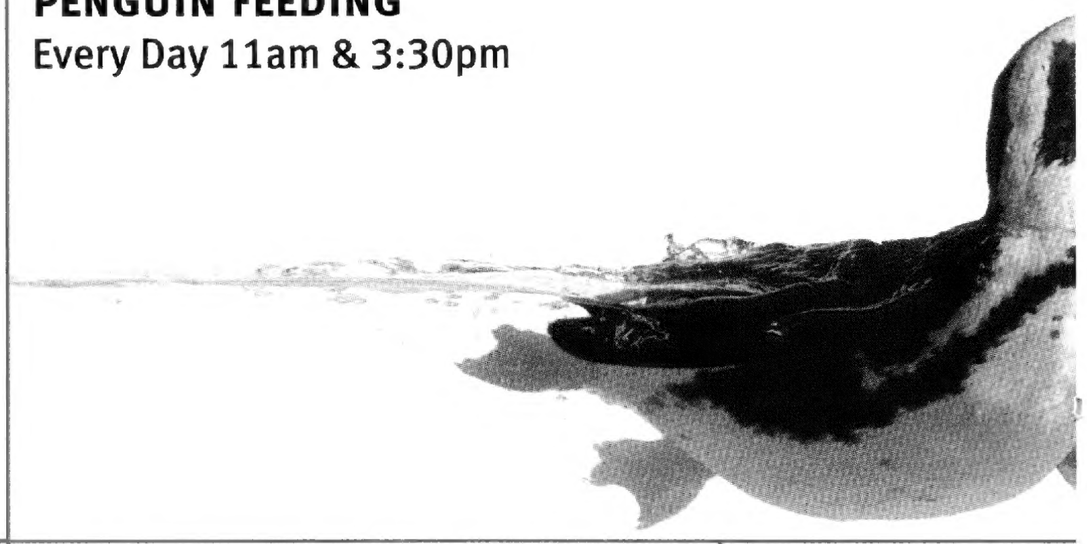
**30**
- Story Time 10:30am
- Penguin Feeding 11:00am
- Penguin Feeding 3:30pm

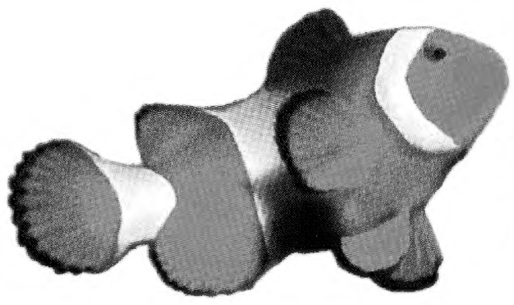
Visit the
**NATURE NEST**
Every Day 10am-5pm



| Sunday | Monday | Tuesday | Wedn |
|---|---|---|---|
| **1**<br>Penguin Feeding 11:00am<br>Penguin Feeding 3:30pm | **2**<br>Penguin Feeding 11:00am<br>Coral Reef Caretaking 2:00pm<br>Penguin Feeding 3:30pm | **PENGUIN FEEDING**<br>Every Day 11am & 3:30pm | |
| **8**<br>Penguin Feeding 11:00am<br>Penguin Feeding 3:30pm | **9**<br>Penguin Feeding 11:00am<br>Coral Reef Caretaking 2:00pm<br>Penguin Feeding 3:30pm | **10**<br>Penguin Feeding 11:00am<br>Penguin Feeding 3:30pm | **11**<br>Penguin Feedi<br>Coral Reef Car<br>Penguin Feedi |
| **15**<br>Penguin Feeding 11:00am<br>Penguin Feeding 3:30pm | **16**<br>Penguin Feeding 11:00am<br>Coral Reef Caretaking 2:00pm<br>Penguin Feeding 3:30pm | **17**<br>Academy Lecture 2:00pm<br>Penguin Feeding 11:00am<br>Penguin Feeding 3:30pm<br>Academy Lecture 7:30pm | **18**<br>Penguin Feedi<br>Coral Reef Car<br>Penguin Feedi |
| **CORAL REEF CARETAKING**<br>Every Monday and Wednesday 2pm | | **24**<br>Penguin Feeding 11:00am<br>Penguin Feeding 3:30pm | **25**<br>Penguin Feedi<br>Coral Reef Car<br>Penguin Feedi |
| **29**<br>Penguin Feeding 11:00am<br>Penguin Feeding 3:30pm | **30**<br>Penguin Feeding 11:00am<br>Coral Reef Caretaking 2:00pm<br>Penguin Feeding 3:30pm | **31**<br>Penguin Feeding 11:00am<br>Penguin Feeding 3:30pm | |







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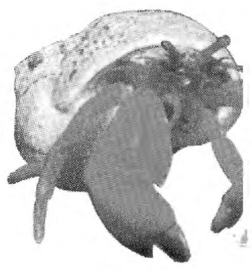
**CORAL REEF CARETAKING**
Every Monday and Wednesday 2pm



http://www.calacademy.o

**O**

*All programs are*
Please see Program
For more informatic

| esday | Thursday | Friday | Saturday |
|---|---|---|---|
|  | **5**<br>Penguin Feeding 11:00am<br>Penguin Feeding 3:30pm<br>Special Lecture 8:00pm *JCC | **6**<br>Members Hours 9:30am<br>Penguin Feeding 11:00am<br>Raptor Dinosaurs 11:30am<br>Raptor Dinosaurs 12:30pm<br>Snake Feeding 2:00pm<br>Penguin Feeding 3:30pm | **7**<br>Story Time 10:30am<br>Penguin Feeding 11:00am<br>Penguin Feeding 3:30pm |
| ng 11:00am<br>etaking 2:00pm<br>ng 3:30pm | **12**<br>Story Time 10:30am<br>Penguin Feeding 11:00am<br>Penguin Feeding 3:30pm | **SNAKE FEEDINGS**<br>Every Friday 2pm | **14**<br>Story Time 10:30am<br>Penguin Feeding 11:00am<br>Penguin Feeding 3:30pm |
| ng 11:00am<br>etaking 2:00pm<br>ng 3:30pm<br>BY<br>ge.com | **19**<br>Penguin Feeding 11:00am<br>Penguin Feeding 3:30pm<br>3rd Thursday 5:00pm<br>3rd THURSDAYS<br>CLOWNFISH, CORALS & COCKTAILS CONVERGE | | **PENGUIN FEEDING**<br>Every Day 11am & 3:30pm<br>  |
| ng 11:00am<br>etaking 2:00pm<br>ng 3:30pm<br>SIGN UP FOR eNews<br>g/enews/subscribe.html | **26**<br>Story Time 10:30am<br>Penguin Feeding 11:00am<br>Penguin Feeding 3:30pm | **27**<br>MUSEUM CLOSES AT 3PM TODAY<br>Members Hours 9:30am<br>Penguin Feeding 11:00am<br>Raptor Dinosaurs 11:30am<br>Raptor Dinosaurs 12:30pm<br>Snake Feeding 2:00pm<br>Dynamite Dinonight 6:30pm<br>*tickets $350 per family<br>see pg 22 for more info | **28**<br>Story Time 10:30am<br>Penguin Feeding 11:00am<br>Halloween Herps 11:30am<br>Halloween Herps 1:30pm<br>BioForum 1:30pm *Oakland<br>Penguin Feeding 3:30pm |

# CTOBER

*ree with Academy admission unless otherwise noted.*
s and Highlights on page 6 for a full description.
n, visit: *www.calacademy.org*.

## PASSPORT THROUGH TIME

Dinosaurs were not the only organisms affected by the extinction event 65 million years ago. Before entering the *DINOSAURS* exhibit, pick up a "Passport Through Time." Each passport contains a detailed profile of a plant or animal that lived during the Age of Dinosaurs. After exploring the exhibit, journey to the Naturalist Center on the second floor to find out if your organism survived the extinction event—your passport will be stamped with the word "EXTINCT" or "EVOLVED"!

| Sunday | Monday | Tuesday | Wedn |
|---|---|---|---|

# NOVEMBER

*All programs are free with Academy admission unless otherwise noted.*
Please see Programs and Highlights on page 6 for a full description.
For more information, visit: *www.calacademy.org*.

**1**
Penguin Feed
Coral Reef Ca
Penguin Feed

**5**
Penguin Feeding 11:00am
Penguin Feeding 3:30pm

**SIGN UP FOR eNews**
http://www.calacademy.org/enews/subscribe.html

**6**
Penguin Feeding 11:00am
Coral Reef Caretaking 2:00pm
Penguin Feeding 3:30pm

**7**
Academy Lecture 2:00pm
Penguin Feeding 11:00am
Penguin Feeding 3:30pm
Academy Lecture 7:30pm

**8**
Penguin Feed
Coral Reef Ca
Penguin Feed

**12**
Penguin Feeding 11:00am
Penguin Feeding 3:30pm

**13**
Penguin Feeding 11:00am
Coral Reef Caretaking 2:00pm
Penguin Feeding 3:30pm

**14**
Penguin Feeding 11:00am
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**15**
Penguin Feed
Coral Reef Ca
Penguin Feed

**19**
Penguin Feeding 11:00am
Penguin Feeding 3:30pm

**20**
Penguin Feeding 11:00am
Coral Reef Caretaking 2:00pm
Penguin Feeding 3:30pm

**21**
Penguin Feeding 11:00am
Penguin Feeding 3:30pm

**22**
Penguin Feed
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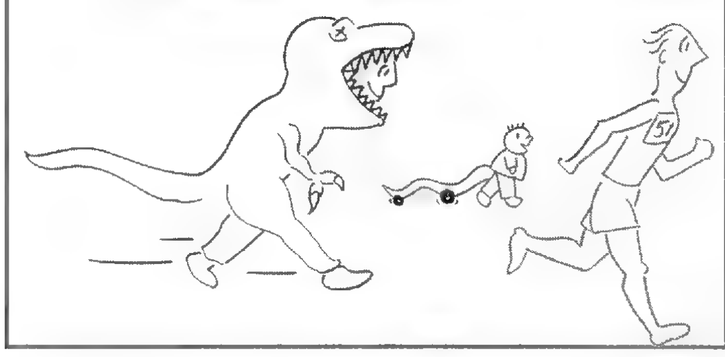
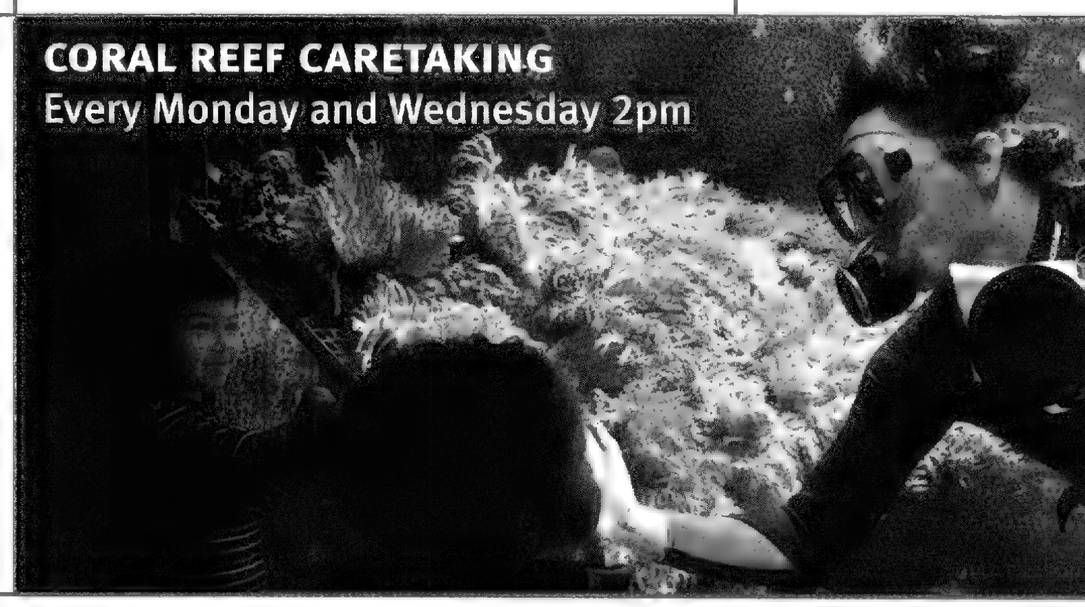
**26** RUN WILD! 8:30am *GGP
Penguin Feeding 11:00am
Penguin Feeding 3:30pm



**27**
Penguin Feeding 11:00am
Coral Reef Caretaking 2:00pm
Penguin Feeding 3:30pm



| esday | Thursday | Friday | Saturday |
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| ng 11:00am<br>retaking 2:00pm<br>ing 3:30pm | **9** Story Time 10:30am<br>Penguin Feeding 11:00am<br>Penguin Feeding 3:30pm | **10** Members Hours 9:30am<br>Penguin Feeding 11:00am<br>Snake Feeding 2:00pm<br>Penguin Feeding 3:30pm | **PENGUIN FEEDING**<br>Every Day 11am & 3:30pm |
| ing 11:00am<br>retaking 2:00pm<br>ing 3:30pm | **16** Penguin Feeding 11:00am<br>Penguin Feeding 3:30pm<br>3rd Thursday 5:00pm<br>3rd THURSDAYS<br>CLOWNFISH, CORALS & COCKTAILS CONVERGE | **17** Members Hours 9:30am<br>Penguin Feeding 11:00am<br>Snake Feeding 2:00pm<br>Penguin Feeding 3:30pm<br>*Last day to pre-register by mail for* **RUN WILD!** | **SNAKE FEEDINGS**<br>Every Friday<br>2pm |
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|  | **30** Penguin Feeding 11:00am<br>Penguin Feeding 3:30pm | | |

# Survivors

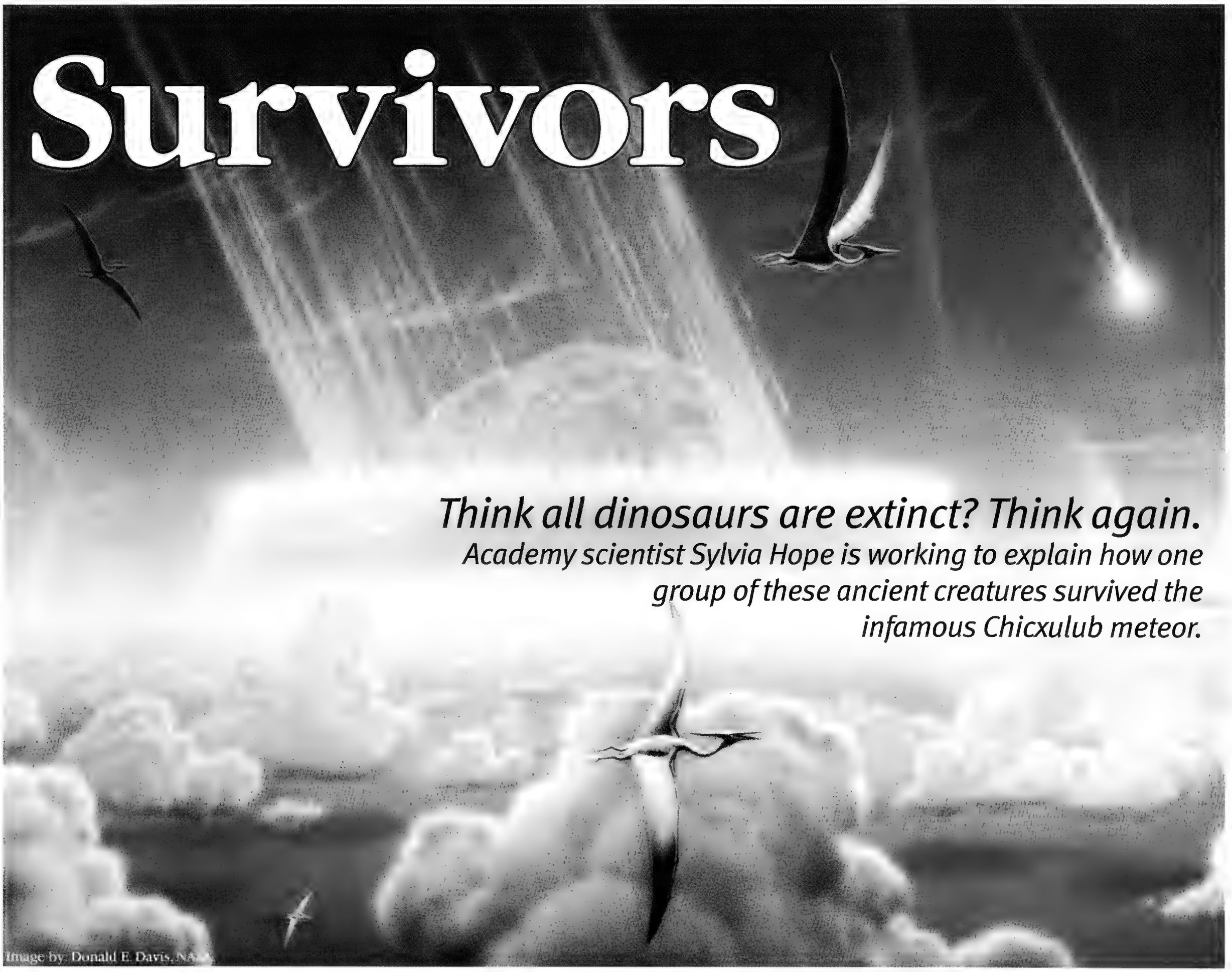


Image by: Donald E. Davis, NASA

## *Think all dinosaurs are extinct? Think again.*

*Academy scientist Sylvia Hope is working to explain how one group of these ancient creatures survived the infamous Chicxulub meteor.*

About 65 million years ago, an asteroid or comet measuring 10-15 kilometers in diameter hurtled through Earth's atmosphere at speeds of over 40,000 miles per hour and crashed into the shallow waters off the coast of Mexico. The resulting crater, which now sits above sea level near the Mayan town of Chicxulub on the Yucatán Peninsula, boasts a diameter of about 180 kilometers and has been documented with both satellite and radar technologies. This event, known as the Chicxulub impact, has been implicated as the cause of a mass extinction that wiped out over half of the known species on the planet, including most of the dinosaurs. However, one group of feathered dinosaurs—known more commonly today as birds—survived the impact, along with a number of small mammals, crocodiles, lizards, snakes, and amphibians.

Historically, scientists have been unable to explain why these animals survived, while non-avian dinosaurs and many other creatures perished. However, a team of geophysicists and paleontologists, including Academy scientist Sylvia Hope, has recently developed a new hypothesis to explain the pattern of extinction. Survival, they say, hinged on the ability of an animal to burrow underground, shelter within natural cavities, or take refuge under water during the first few hours after the impact.

Past attempts to explain the post-Chicxulub extinction pattern have typically focused on the ability of species to withstand the high levels dust, soot, sulfates, acid rain, nitrogen

### WAS CHICXULUB THE ONLY CULPRIT?

What caused all the chaos 65 million years ago? Not all scientists agree. There's no doubt that a comet or asteroid hit Earth around that time, and little doubt that the impact had deadly consequences for life on Earth. But other factors, including climate shifts caused by changing sea levels, may also have played a role in wiping out at least half of all the species alive at the time, including the non-avian dinosaurs. Some studies suggest that the dinosaurs began to disappear gradually due to changes in environmental conditions and plant assemblages well before the Chicxulub impact, while others favor the hypothesis that the asteroid caused a sudden demise. Extinction theories continue to evolve as more scientific evidence surfaces.

oxides and other toxic compounds that were created by the Chicxulub impact. While these conditions certainly posed a threat to all species, they may have been only secondary agents of stress. New analysis from geophysicists at University of Colorado suggests that the most immediate ramification of the impact was actually intense infrared radiation, so strong that it would likely have been lethal within just a few minutes of direct exposure. When the Chicxulub impact occurred, debris from the meteor was almost instantly vaporized and lofted high above the atmosphere, where it spread out around the world. When this vapor debris cooled, it condensed into small glassy particles called spherules that rained back down upon the entire planet. As they reentered Earth's upper atmosphere, the spherules melted and became incandescent, sending scorching infrared radiation through the sky and igniting firestorms wherever there was vegetation. This process released 10,000 times more thermal energy than the combined arsenal of Cold War nuclear war heads could have produced.

The geophysicists on the team were able to estimate the extent of the energy released by studying the crater size and tracing the remains of the fallout spherules, which are distributed across the planet—as far away from the impact site as New Zealand and the fringes of Antarctica. Even in New Zealand, the spherules are so plentiful that the infrared radiation they produced would have been sufficient to ignite fires across the country. However, a mere 10 centimeters of soil or a few micrometers of water would have provided enough insulation to protect most animals. Thus, the team began to wonder if sheltering behaviors were a determining factor in survival. To examine this idea, they turned to a group of paleontologists who study fossils from the late Cretaceous, including Sylvia Hope.

A member of the Academy's Department of Ornithology and Mammalogy, Hope has dedicated much of her career to studying fossil birds from the late Cretaceous. The record is not extensive—bird bones must be especially light to allow for flight, so they are highly fragile and fossils are often fragmentary at best. However, Hope has inspected so many of these fragments that she can draw a surprising amount of information from a single bone. The most common bone in the bird record is the coracoid, a shoulder bone that supports powerful flight muscles and is therefore especially dense and durable. The bone shape and patterns of muscle attachment sites can indicate not only the identity of the bird but also its musculature and related flight skills. From a single coracoid bone, Hope can often identify a fossil to the species level. Based on the information she has gleaned so far from the fossil record, it appears that most avian survivors of the Chicxulub impact had some sort of burrowing, diving, or sheltering strategy. Although some identifications are tentative, birds that escaped extinction likely included the ancient relatives of ducks, geese, cormorants, loons, shorebirds, and chickens.

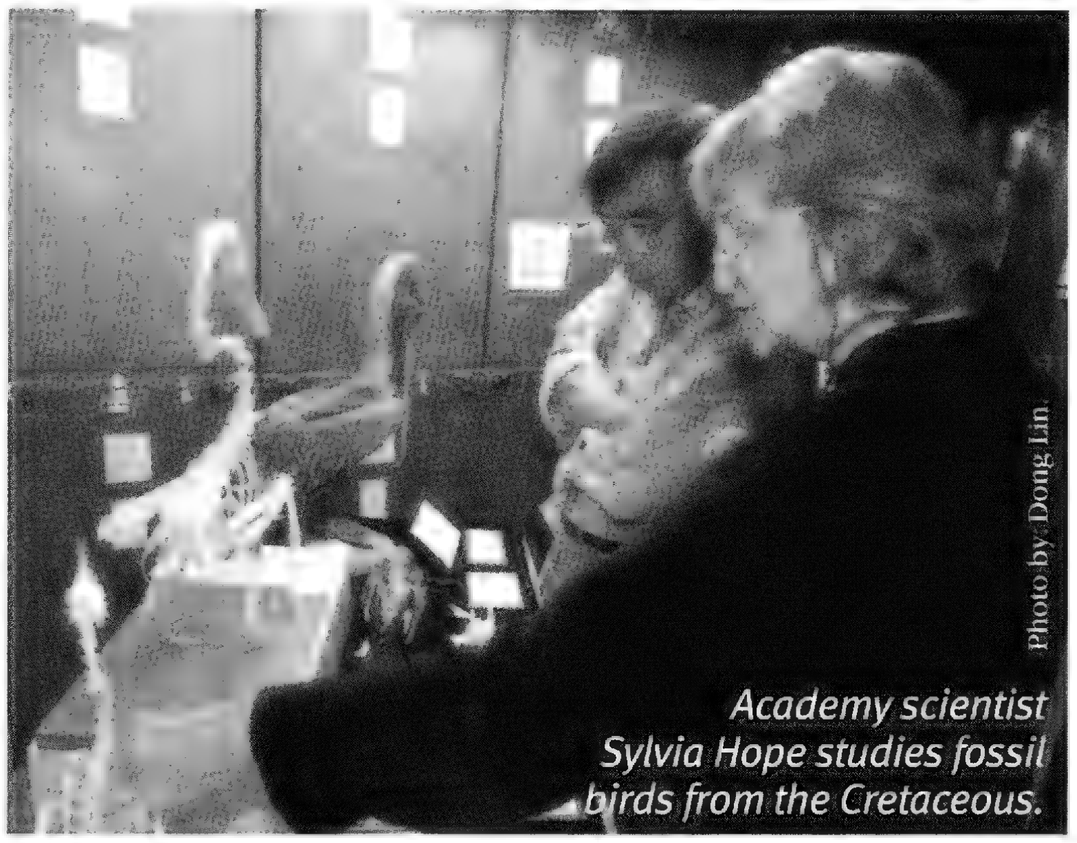


Photo by: Dong Lin

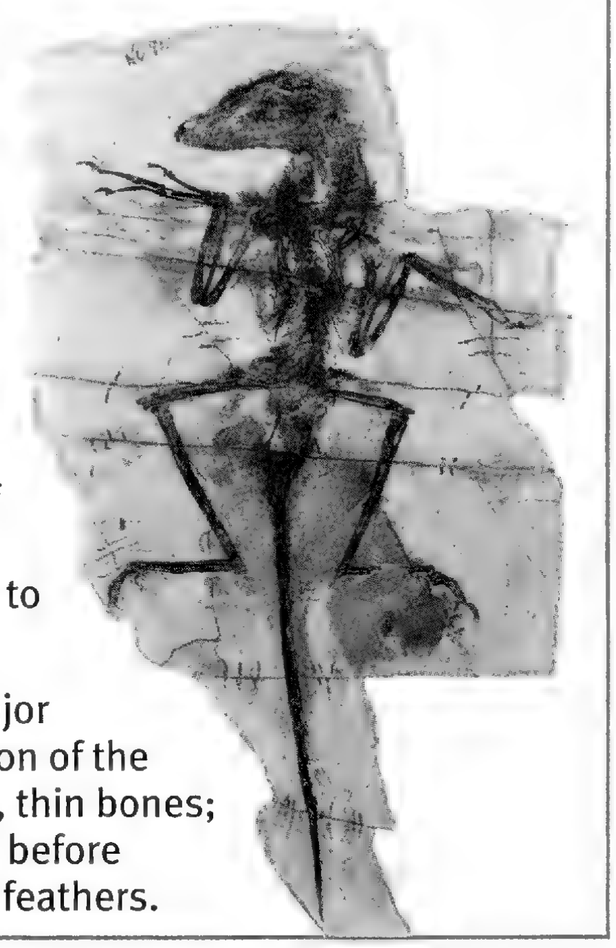
*Academy scientist Sylvia Hope studies fossil birds from the Cretaceous.*

Sheltering behaviors in the closest living relatives of these birds provide some clues as to how these animals survived the impact. Shorebirds might have found protection beneath the dense, wet vegetation of marshy ecosystems. Petrel-like remains suggest that other birds present were able to dive, surfacing only briefly to breathe. Still others could have sheltered inside a rock pile or burrow as penguins do today. Many of the smaller arboreal birds today—as varied as woodpeckers, kingfishers, and owls—use natural cavities or burrows, or excavate their own. It would seem that a critical difference between the birds that survived and the flying pterosaurs that did not is that, from what is known of their anatomy, pterosaurs did not swim, dive, or burrow.

The team has now published its initial results, but Hope's work with the pre- and post-impact fossil record is far from finished. She is currently studying newly unearthed fossils from Cretaceous sites in the Chatham Islands just east of New Zealand. "I'm not trying to either prove or disprove the sheltering hypothesis!" she says with a laugh. "I'm just collecting the evidence that will help us evaluate the idea. Either way, the implications for understanding the evolution of birds are exciting."

### ARE BIRDS REALLY DINOSAURS?

Even though they seem very different from lumbering tyrannosaurs and sauropods, the idea that modern birds are living dinosaurs is now accepted by most paleontologists. Molecular and morphological data suggest that the first birds originated 125-145 million years ago from a group of small, nimble, feathered dinosaurs called dromaeosaurs. These ancient birds flourished in the skies for millions of years and multiplied into many groups. Among them, the group called Neornithes ("new birds") branched off from other birds about 90-100 million years ago. Only Neornithes survived through the end of the Cretaceous to produce the many kinds of birds that exist today.



Modern birds and dromaeosaurs share a number of major skeletal characteristics, including the shape and position of the pubic bone; elongated, folded arms with claws; hollow, thin bones; and stiffened tails. Additionally, like the dromaeosaurs before them, modern birds lay eggs and have both scales and feathers.

# EXTRASOLAR PLANETS

The Fall sky offers an opportunity to identify the location of one of the 188 planets known so far to orbit stars other than the Sun. These "extrasolar planets," as they're called, have been discovered since 1994. Three are small, rocky objects orbiting a pulsar, or the remnant of an exploded star, while the rest and are mostly very large, Jupiter-class objects. The first to be discovered orbiting a Sun-like star was found along the leading—or western—side of the Great Square of Pegasus, which is prominent in the east in the hours after sunset. Supposedly the shape of a great, winged horse, Pegasus is more easily imagined as a baseball diamond, complete with catcher and pitcher. The northern side is the home plate-to-1st baseline, the eastern side is 1st base-to-2nd, the southern side is 2nd base-to-3rd, and the western side is 3rd base-to-home (the Moon can be seen just to the south of the Great Square on September 7th & 8th, October 5th, and November 1st). About halfway along the 3rd base-to-home line and slightly outside the diamond is the star 51 Pegasi, some 50 light years away and easily visible with a pair of binoculars, although its planet isn't. The planet, 51 Pegasi b, is about half the mass of Jupiter and orbits the star once every 4 days at a distance of less than 5 million miles.

## September 7 ○

***Full Moon***, also called the "Cool Moon" by the Cheyenne, the "Wild Rice Moon" by the Ojibway, and the "Mulberry Moon" by the Choctaw. Occurring only hours before perigee (the Moon's closest approach to Earth), this Full Moon brings higher tides than usual. A ***partial lunar eclipse*** can be seen from the entire nighttime side of Earth, centered on India (unfortunately for the U.S., this is during daylight hours, when the Full Moon will still be below the horizon). Earth's shadow passes over the lunar north polar region, reddening it noticeably and encroaching across 19% of the Moon's disk.

## September 22 ●

Today's ***New Moon*** occurs shortly after apogee (the Moon's greatest distance from Earth). In fact, the Moon does pass directly in front of the Sun on this day, causing a solar eclipse, but because apogee makes it appear smaller than usual, the Moon doesn't completely cover the Sun's disk, as during a total eclipse. Instead, this is called an ***annular solar eclipse***, because a ring of the solar disk – or "annulus" – remains visible around the New Moon. This will be visible from the southern Atlantic, south of the Horn of Africa, and the southern Indian Ocean. The only land touched by the Moon's shadow includes portions of Guyana, Surinam, and French Guiana.

The Moon is vital to some cultures for calendar purposes. Both the Muslim and Jewish calen-dars mark months from the first thin crescent Moon visible after "New." This month, that crescent marks the start of ***Ramadan***, the month of fasting in the lunar-based Muslim calendar, as well as the start of ***Tishri***, the seventh month in the Hebrew calendar, and ***Rosh Hashanah***, the Jewish new year.

***Autumnal equinox*** (beginning of Autumn for the Northern Hemisphere) at 9:06 p.m. PDT (calendars based on Greenwich or even on Eastern Time list this as occurring on the 23rd). South of the Earth's equator, this marks the start of the Spring season.

## October 6 ○

***Full Moon.*** Being the nearest to the Autumnal Equinox, this Full Moon is called the "***Harvest Moon***," though it should be noted that most Harvest Moons usually occur in September. This is also known to the Cheyenne as the "Moon When Water Begins to Freeze on the Edge of the Stream" and to the Nez Perce as "Falling Leaves Time" – very evocative names describing events characteristic of the season. As was the case last month, Full Moon falls on the same day as ***perigee***, resulting in higher tides than usual.

## October 21 ★

Peak of the ***Orionid meteor shower***, considered a major shower, with 20-25 swift meteors per hour, caused by dust particles from Halley's Comet falling through Earth's atmosphere. Conditions are ideal: with the shower occurring on the night of ***New Moon***, moonlight won't interfere with viewing. Some tables list New Moon as falling on the 22nd, but that's as reckoned in either Eastern or Greenwich Time – converting to Pacific Time backs it up to before midnight of the 21st. The first thin crescent after New won't be visible until sunset of the 23rd, marking ***Eid-al-Fitr*** and the start of the month ***Shawwal*** in the Moon-based Islamic calendar and the month ***Cheshvan*** in the Hebrew calendar.

## October 29

As on every last Sunday in October since 1966, most of the United States and its territories (except for American Samoa, Hawaii, Puerto Rico, the Virgin Islands, and parts of Arizona & Indiana) gain an hour of sleep as we ***change from Daylight Savings Time back to Standard Time***. At 2:00 a.m. – or at bedtime on Saturday night – adjust clocks back one hour ("spring forward, fall back").

## November 5 ○

***Full Moon***. As the Full Moon immediately after the Harvest Moon, this is called the "***Hunter's Moon.***" It was also called the "Beaver Moon" by the Algonquin, the "Bison Moon" by the Natchez, and the "Raccoon Breeding Moon" by the Osage.

## November 17 ★

Peak of the ***Leonid meteor shower***, which usually averages a modest 15 meteors per hour. Since the shower coincides with a waning crescent Moon that rises shortly before dawn, this should be a good year to observe the Leonids, which are among the swiftest of the meteors, many with persistent, long-lasting trains.

## November 20 ●

***New Moon.*** The first sighting of the crescent moon at sunset on the evening of the 22nd begins the month ***Zul-Qa'dah*** in the Muslim calendar and ***Kislev*** in the Hebrew calendar.

| | SUNRISE | LOCAL NOON | SUNSET |
|---|---|---|---|
| SEPTEMBER 1 | 6:40 AM PDT | 1:09 PM PDT | 7:39 PM PDT |
| OCTOBER 1 | 7:05 AM PDT | 12:59 PM PDT | 6:53 PM PDT |
| NOVEMBER 1 | 6:30 AM PDT | 11:53 PM PDT | 5:11 PM PDT |

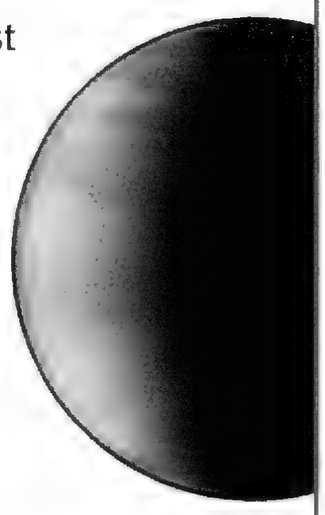
*(Times are for San Francisco, CA, and will vary slightly for other locations.)*

# The Planets

## Mercury

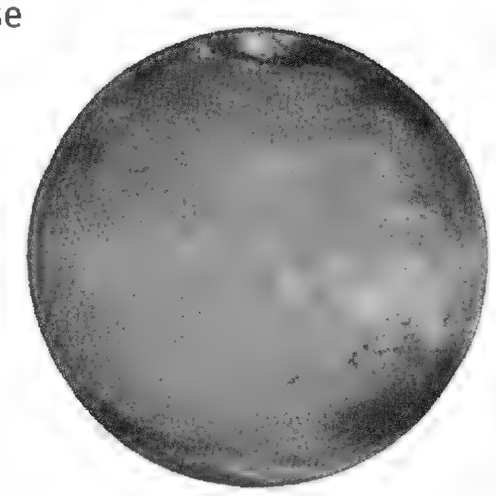
Usually too near the Sun and washed from view by the glow of our star, Mercury is at superior conjunction on September 1st and emerges into the evening sky in late October but is difficult to see because of the low angle of its path. Swinging around to the other side of its orbit, Mercury crosses directly in front of the Sun on November 8th and – if viewed using safe methods – can be seen as a tiny dot on the solar disk. This is called a "transit" and won't happen again for 10 years. The Moon passes nearby on the evenings of September 23rd (very close to the Sun) & October 23rd (still rather difficult) and on the morning of November 19th (easiest).

## Venus



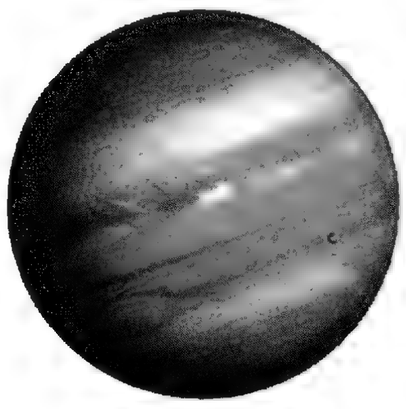
A predawn object, Venus is moving away from its August 26th close encounter with Saturn and is descending into the Sun's glow. You may be able to see it pass the star Regulus, low in the east before sunrise, on September 6th. By October, it disappears behind the Sun, passing superior conjunction on the 27th, and doesn't emerge into the evening sky until December. The crescent Moon's close approaches to Venus are also too close to the Sun to see, occurring on September 21st, October 21st, & November 21st.

## Mars



Plunging into the glow of the setting Sun as it sets in the west, the Red Planet passes close to Mercury on the evenings of September 13th & 14th, then is washed from view as it departs the evening sky. In conjunction with the Sun, invisible in its glare, on October 23rd, it reappears in the pre-dawn sky, rising in the east before the Sun in mid-November and making a close pass near Mercury on November 11th. The Moon passes nearby on the evening of September 22nd and on the morning of October 21st (though at both times too close to the Sun to be seen), and, more visibly, on the morning of November 19th (both objects forming a pretty triangle with Mercury).

## Jupiter



The largest planet begins the quarter as an evening object, gradually descending into the west and disappearing into the Sun's glow by mid-October. Passing behind the Sun and moving into conjunction on November 21st, it doesn't emerge into the morning sky until early December. The Moon can be seen near Jupiter on the evening of September 25th & 26th, but its passes on October 23rd, & November 20th are too close to the Sun to view.

## Saturn

The beautiful Ringed Planet is a predawn object against the stars of Leo the Lion, rising in the east shortly before the Sun in September. Even a small astronomical telescope brings its magnificent rings into view. As the season progresses, it rises slightly earlier each day, and by November, it's rising at about midnight and is due south at dawn. The Moon passes by on the mornings of September 18th & 19th, October 16th and on November 12th.

# Introducing this Issue's Volunteer:


"My work at the Academy has been a journey of discovery," says Bertha Jones, a herbarium volunteer in the Academy's Botany department. Jones spends most of her volunteer hours mounting incoming specimens, which requires a good eye and patience—each new specimen must receive a unique accession number, be attached to acid free paper, and be organized by scientific name. Over the years, her hard work has been rewarded with a few special finds. Jones remembers "one ratty looking specimen that had never been mounted, which turned out to be from Captain Cook's first voyage. It was two hundred years old, a long-forgotten gift from the British Museum!"

Throughout their lives together, Jones and her husband were active volunteers. They lived by Ralph Waldo Emerson's observation that "one of the beautiful compensations of life, [is] that no man can sincerely help another without helping himself." Today, Jones finds that "being part of history" at the Academy keeps her alert to the new and wondrous. She admires the Academy's Howard Street museum for its quick reincarnation, and she looks forward to 2008, when the museum will reemerge in Golden Gate Park. Her tradition of volunteering, she assures us, will continue unabated. Not bad for a woman in her 90th year!

**Interested in volunteering?**
**Call 415-321-8111**
**or e-mail rhenning@calacademy.org**

# Dino-mite Deal

As always, Academy members will receive free admission to the museum during the *DINOSAURS* exhibit. Admission prices for non-members will be raised for the duration of the exhibit to $10 for adults; $6.50 for youths ages 12 to 17, seniors ages 65 and above, and students with valid ID; and $2 for children ages four to 11. Children three and younger will continue to receive free admission. If your membership is about to expire, this is a great time to renew your status as an Academy member to enjoy additional savings. Additionally, the museum will open for special members-only hours every Friday at 9:30 am from September 22 through the duration of the exhibit. Memberships can now be renewed online at www.calacademy.org/store.

# ACADEMY TRAVEL PROGRAM 2007

***The mission of the Travel Program is to offer Academy-led tours that place members in the context of specifically chosen natural environments. Teaching, understanding, and conservation are our goals.***

## Treasures of Japan:

### Classic Gardens, Temples and Castles

*Co-sponsored by the San Francisco Botanical Garden Society*

April 15 – 26, 2007
Leader: Mona Bourell

***'Treasures of Japan' is only one of the many Academy-led tours. Listed below are more travel opportunities.***

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Aboard the *Sea Bird*
February 10 – 17, 2007
Leader: Healy Hamilton

**Trinidad: Undiscovered Gem of the Caribbean**
February 11 – 17, 2007
Leader: Tom Daniel

**The Wonders of Costa Rica and Panama**
Aboard the *Voyager*
March 10 – 17, 2007
Optional Extension to Monteverde Cloud Forest
Leader: Chris Andrews

**Galápagos**
Aboard the *Islander*
April 28 – May 7, 2007
Leaders: Bob and Gail Drewes

**Alaska's Inside Passage**
Aboard the *Sea Bird*
June 17 – 24, 2007
Leaders: Dave and Bev Kavanaugh

**The Natural Treasures of Brazil**
September 2007 (dates to be determined)
Leaders: Frank and Mary Beth Almeda

**Wildlife Safari to South Africa and Mozambique**
August/September 2007 (dates to be determined)
Leaders: Terry and Bonnie Gosliner

**Mexico's Copper Canyon**
October 6 – 14, 2007
Leader: Jean DeMouthe

**China's Southern Silk Route and Tibet**
October 2007 (dates to be determined)
Leader: Jack Dumbacher

**Polar Bears of Churchill**
October 30 – November 5, 2007
Leader: Meg Burke

**Natural Wonders of the Red Sea, Jordan, and Egypt**
Aboard *Le Levant*
December 7 – 21, 2007
Leader: Bob Van Syoc

**For brochures or further information, please contact the Academy Travel Office**
**Phone: 415.901.8129 or 800.853.9372 E-mail: calacademy@hcptravel.com**

# Spiders that *Hunt* Together *Stay* Together

*The power of teamwork:*
*these social spiders can tackle larger prey by working together.*

Photo by Jeremy Miller

In January of 2006, Academy entomologist Jeremy Miller traveled to Eastern Madagascar to study the region's spiders. He and his Academy colleague Hannah Wood were the first arachnologists to survey the dry, deciduous forests in the area, so he wasn't necessarily surprised to find a new species living there. He was, however, amazed by the behavioral traits he witnessed when he encountered a new species in the spider family Scytodidae, the members of which have earned the nickname "spitting spiders" by literally spitting for their supper. These talented arachnids can trap prey from as far away as 60 millimeters (about ten times their own body length) by spewing out a mixture of venom and glue. As impressive as this spitting tactic is, however, it was not the behavior that made Miller stop in his tracks. The big surprise was that the spiders were living together in colonies.

**Communal living may seem mundane compared to projectile poison, but it is actually incredibly rare among arachnids.**

*After two spitting spiders caught this fly, four other colony members joined in the feast.*

Image by Jeremy Miller

Most spiders are solitary creatures—once they reach adulthood, they seek each other out for one of only two reasons: to mate or to eat one another. However, a handful of species have developed a more tolerant attitude toward their kin. Of the approximately 40,000 known species of spiders on the planet, about 20 live in cooperative family groups that stay together for generations. This social behavior has evolved independently several times and probably develops gradually, as females begin extending maternal care to older and older juveniles. By living together, social spiders can share the responsibility of building webs and capturing prey.

The new spitting spider that Miller discovered in Madagascar (*Scytodes* sp.) lives in groups of up to 16 individuals, including juveniles and adults of both sexes. The species builds webs by weaving together debris, leaves, and branches with strands of silk. Besides providing shelter for the spiders, these roughly baseball-sized webs also help to ensnare passing prey. Once a potential meal lands on the web, the spiders team up to help tackle the tasty morsel. Approaching from multiple angles, they use their hind legs to comb silk over their prey and—if the prey is particularly feisty—they spray the entangled intruder with toxic, sticky spit. Mature males, mature females, and juveniles all participate in the prey capture, and they share the fruits of their labor quite freely—even spiders that did not assist in the tackle are permitted to partake in the meal.

These social spitting spiders are able to subdue much larger prey by working as a team than they could by attacking alone. On one occasion, Miller watched a single female attempt to capture a roach that was about twice her size. She managed to tenuously entangle the roach in her silk, but the bigger bug eventually escaped. Roaches of the same size were successfully captured, however, when two or more spiders worked together. Teams of spiders were also able to hunt other large prey, including moths and flies.

Most species of spitting spiders do not actually build webs to capture prey. The new species that Miller encountered, however, follows the trend of almost all other social spiders by building

communal webs. The webs, which vibrate when anything hits them, seem to assist in prey capture by simultaneously alerting multiple colony members to the presence and location of potential prey.

Although they tow the party line when it comes to web building, Miller's spiders differ from most other social spiders in another regard: sex ratio. As a general rule, most social spiders have little or no contact with spiders outside their own colony, so mating occurs between family members. As a result, colony members carry virtually identical genes. Under these circumstances, the competitive pressure for individuals to pass down their own genetic information disappears, and the needs of the colony as a whole take precedence. Colonies can grow faster if most of the offspring are female, so most social spiders live in colonies that are about 90% female. Only a few males are needed in each colony for egg fertilization. Miller was therefore surprised to find that in the 61 colonies of social spitting spiders he documented, the sex ratio was almost equally split between males and females. This suggests that there is likely a substantial amount of interaction and gene flow between colonies of *Scytodes* spiders. It also implies that—despite their table manners—these spitting spiders may be the top socialites in the spider world.

*This silk-encrusted web is unusual not just for its creative use of debris, but also for the number of spiders it houses.*

Image by: Jeremy Miller.

# Spitting Out the Details

Spiders of the family Scytodidae have a skill that would make even Spider-Man jealous—they can immobilize prey without ever having to engage in body-to-body combat by spitting out a net of sticky venom. Glands that hold both venom and glue are located inside the abnormally large heads of these spitting spiders. By rapidly contracting muscles at the back of their heads, the spiders can squirt out a mixture of poison and glue, which quickly sticks their prey to the ground and causes paralysis.

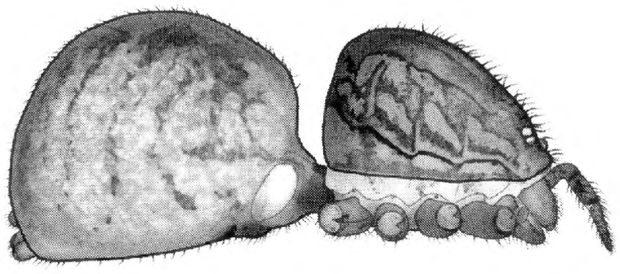
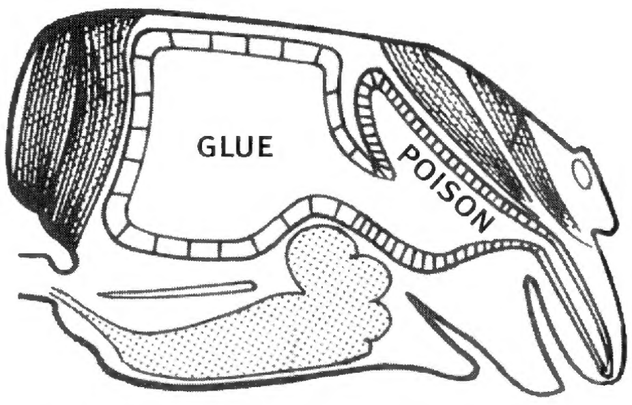


Image by: Jeremy Miller.

*The large head of this new spitting spider (Scytodes sp.) accommodates its venom and glue glands.*




*Scytodes head cutaway diagram.*

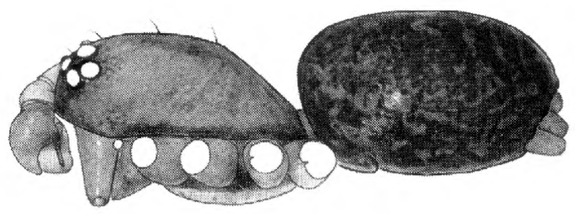
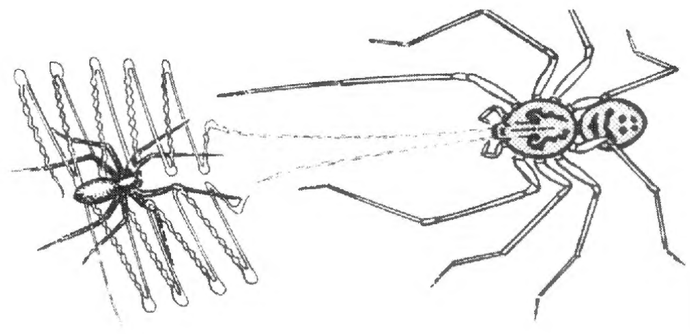


Image by: Jeremy Miller.

*This Synaphris spider from Madagascar displays a more typical head shape.*



*Spitting pattern of Scytodes spider.*

## UPCOMING SPECIAL EVENTS

The Academy is delighted to announce the arrival of a new exhibit, *DINOSAURS: Ancient Fossils, New Discoveries (September 16, 2006-February 4, 2007)*. To celebrate, the Academy is hosting a range of special events for Members, Friends, and the Guild. We hope you can join us!

*DINOSAURS is made possible in part by our sponsors, The Safeway Foundation and Charles R. Schwab, with additional support from the Charles Schwab Foundation.*

THE SAFEWAY FOUNDATION

Charles R. Schwab

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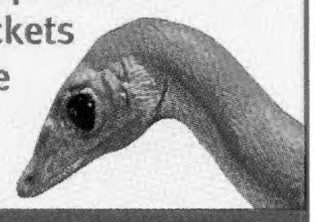
### September 14 from 6:30-8:30 p.m. *Thursday*
### FRIENDS OPENING NIGHT OF DINOSAURS

Join Friends and Academy Trustees for a special opening reception for this exciting exhibit. Relax with cocktails and hors d'oeuvres while getting a sneak preview of the exhibit before it opens to the public. This event is offered to new and current Friends of the Academy. For information, please call Jeanna Yoo at 415.321.8413 or email jyoo@calacademy.org.

### September 16 from 8:00-10:00 a.m. *Saturday*
### MEMBERS BREAKFAST WITH THE DINOSAURS

Enjoy a continental breakfast while exploring the *DINOSAURS* exhibit! This special preview is free to all members. Simply present your membership card at the door. Non-member tickets are $15 each and may be purchased at the door the morning of the event. *Please note: Members' guest passes are not valid for members-only events.*



### October 27 from 6:30– 8:30 p.m. *Friday*
### DYNAMITE DINONIGHT: *15th Annual Halloween Costume Party*

Presented by the Academy Guild and co-chaired by Lucy Hume and Shannon Davis, the evening includes hands-on, dino-inspired activities, Academy scientists showcasing ghoulish specimens, live entertainment, and a delectable reception for both children and adults.

Benefactor tickets are $2,500, $1,000, and $500 per family and include admission to the pre-party from 5:00-6:30pm. General tickets are $350 per family and go on sale September 8.

For more information, call 415.321.8405 or email guild@calacademy.org. This event sells out, so please purchase your tickets early.

## RENT THE ACADEMY

The Academy is available for corporate and private evening events. Guests can stroll through natural history exhibits, interact with live animals in the Discovery Tidepool, and relax in Steinhart Aquarium among colorful and intriguing species–including Steinhart Aquarium's African Penguin colony. For more information contact Anne Rianda at 415.321.8148 or arianda@calacademy.org.

# THANK YOU

*Gifts received March 1–May 31, 2006.*

## Friends of the Academy

***Gifts of $1,000 and above to the Academy's Annual Fund.***

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*The Academy has made every effort to ensure the accuracy of donor lists. Should you find an error, please contact Marlene Dabis at mdabis@calacademy.org or 415.321.8405.*

## Academy Guild Spring Fling

On May 17, Steinhart Aquarium Director Chris Andrews introduced Guild members to a baby alligator during an evening of crafts, scavenger hunts, and live animals.

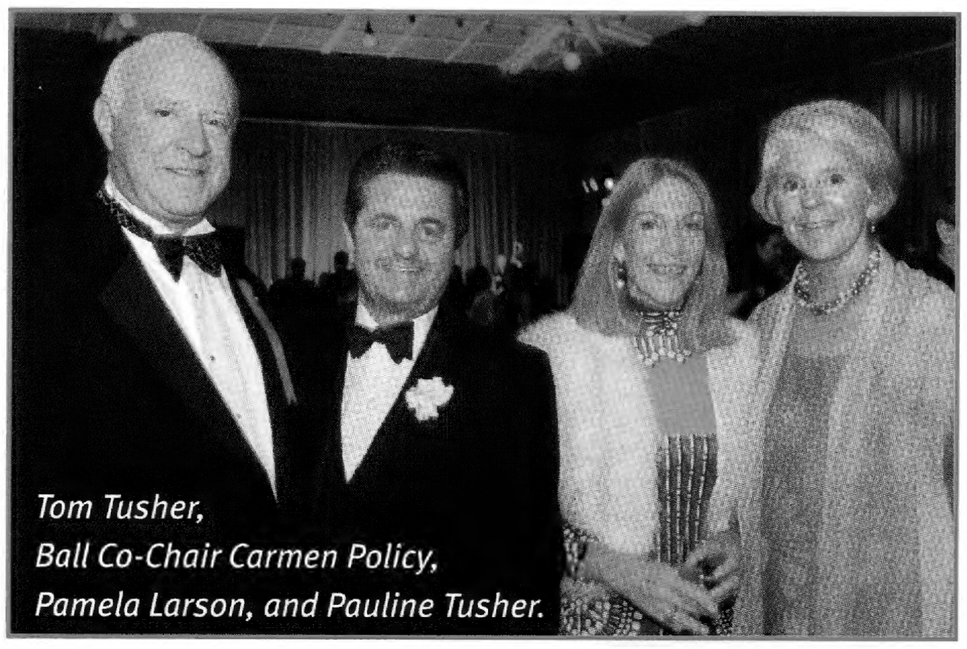
To join the Guild, call 415.321.8405 or email guild@calacademy.org.

## Friends of the Academy

On June 12, Martha Kropf, Arthur Roth, Lois Roth, and Lucia Matzger got a sneak peek at the new Academy during a special Friends Reception at the de Young Hamon Tower.

**Friends of the Academy are offered private tours of the DINOSAURS exhibit in the morning before the Academy opens to the public. For more information, please call Jeanna Yoo at 415.321.8413 or email jyoo@calacademy.org**

## 21st Academy Ball Hot, Hot, Hot



*Tom Tusher, Ball Co-Chair Carmen Policy, Pamela Larson, and Pauline Tusher.*

On May 5, 2006, approximately 500 guests enjoyed a spectacular evening of cocktails, dinner, dancing, and unique Academy entertainment at San Francisco's City Hall. Proceeds from the evening benefit Academy research, exhibits, and education programs.

***Corporate and Foundation Sponsors:***

**Presenting Sponsor ($50,000)**

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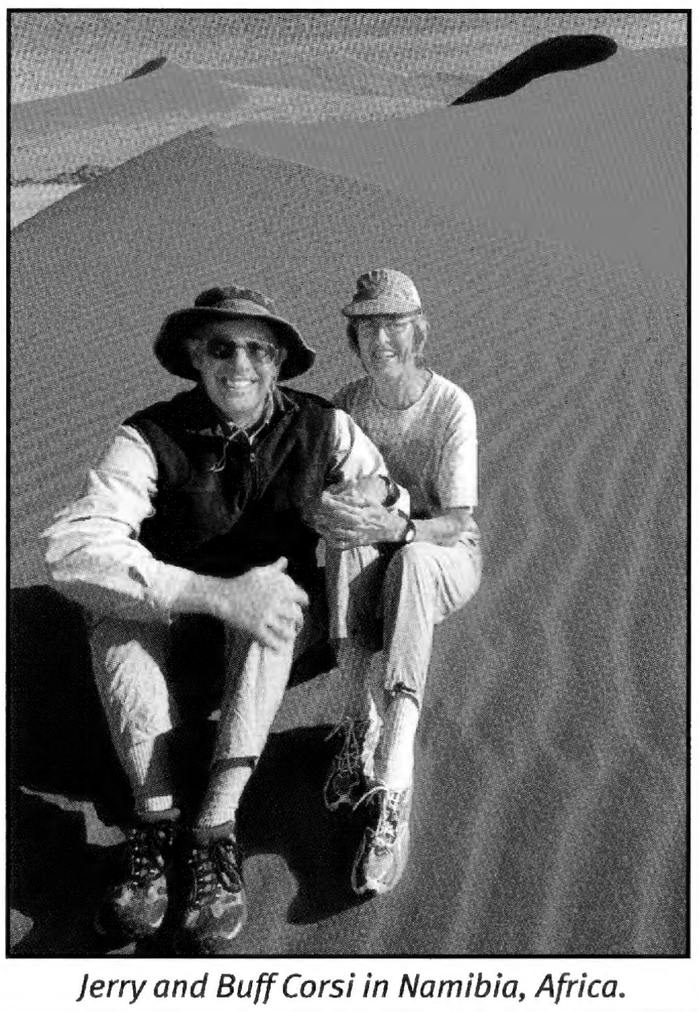
## Eastwood Tradition

**Jerry Corsi, Chair, Eastwood Council**

Nature photographers Jerry Corsi and his wife, Buff, travel the world, often to remote places where they capture the changing natural world through their camera lenses. Their beautiful photos have appeared in hundreds of books and magazines, and each year the Corsis donate thousands of their images to the California Academy of Sciences' collections. Buff and Jerry have also included the Academy in their estate plans and are active members of the Eastwood Associates, the Academy's honorary council for those who have made legacy gifts. Jerry recently committed to a new adventure: assuming the leadership role of Chair of the Eastwood Council and acting as spokesperson for the Academy's legacy giving program. Jerry says, "I am excited to help other longtime Academy friends learn about the Eastwood Associates and how important we are to the museum's future." Council members include Buff, Academy botanist Frank Almeda, past Eastwood Council Chair Merv Dowd, Mike Marron, Betty Shurtleff, Clare Wheeler Sias, and Joan Steinberg, as well as new Council members Mike Bennett and his wife Leslie Larson, Margery Schindler, and Janet Von Doepp.

**For information about Eastwood Associates, please contact Louise Gregory at 415.321.8407 or lgregory@calacademy.org.**



*Jerry and Buff Corsi in Namibia, Africa.*

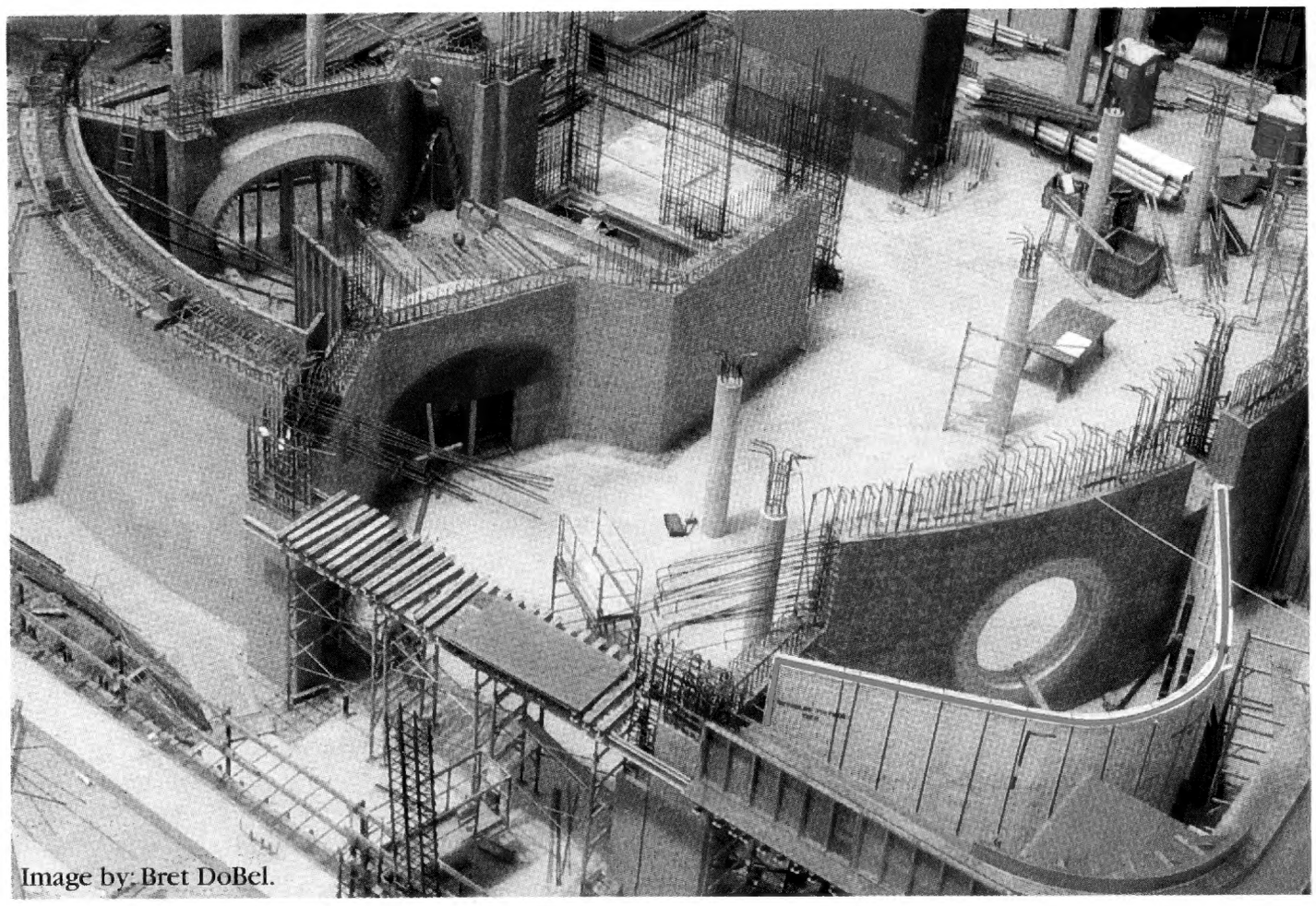


Image by: Bret DoBel.

*Left: The concrete walls of the Flooded Forest tank and the Rocky Coast tank were poured in July. The large viewing window (red) for the Rocky Coast tank was baked inside a temporary oven on the construction site.*
*Above: Visitors will have an expansive view of a California Coast ecosystem when the new Academy opens in 2008.*

Although the new Academy design boasts many innovative features, the most iconic is undoubtedly the undulating roofline. Over the past several months, the hills that make up this roofline have begun to take shape. The curved steel skeleton of the new Morrison Planetarium dome is now in place, and installation of the roof steel that tops the dome is currently underway. This roof steel demonstrates extreme geometry in its curvature—the most radical beams span 96 feet without support from structural columns and feature slopes of up to 60 degrees. Beneath the roof steel, the hemisphere-shaped dome is tilted at a 30 degree angle and supported by a series of cantilevered beams. The lifted side of the hemisphere hovers over the shallow end of the Coral Reef display, where sharks and rays will eventually swim.

All five viewing panels for the 212,000 gallon Coral Reef tank have now been installed, including the main reef window, which measures 30 feet wide, 17 feet tall, and 9 inches thick. Acrylic windows have also been installed in many of the other large aquarium tanks, including the Swamp, the alligator gar tank, the Flooded Forest display in the rainforest, and the penguin habitat. While all of these installations brought their own set of challenges, the most difficult panel to install was the main viewing panel in the 100,000-gallon California Rocky Coast tank. The panel, which stretches around two sides of the tank in an L-shaped curve, was too large to be transported by truck through city streets, so it was shipped to the site in two pieces. In order to bond these pieces together once they arrived, the acrylic installation team had to build an enormous oven inside the Rocky Coast tank. The tank's concrete walls made up three sides of the oven; the oven's fourth wall and roof were formed with special concrete blankets. The bonding process took nearly a month to complete, since the oven had to be heated and cooled very slowly to prevent the panel from cracking. In late July, the bonded panel was polished and moved into place in the tank. When visitors to the new Academy press up against the panel to view the tank's inhabitants, the seam between the two sides will be completely invisible.

Over the next several months, the four-story rainforest dome will also begin to take shape. Now that the Flooded Forest tank is complete in the bottom level of the exhibit, the ramp that will lead visitors through the upper levels of dome is starting to spiral toward its summit. The ramp's curves follow such a complex path that the Academy hired a contractor that specializes in roller coasters to bend the steel for the job. Soon, the rainforest's glass dome will begin to wrap around the outside of this ramp. To view updated photos of this installation process, visit our website: calacademy.org/newacademy. New photos of the building site will be added weekly.

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